

# THE BURDEN OF DIABETES IN SOUTH CAROLINA

**2012 REPORT**

Office of Chronic Disease  
Epidemiology and Evaluation



## Acknowledgements

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## Acronyms

ACSC	Ambulatory Care-Sensitive Conditions
AAF	African American Female
AAM	African American Male
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
CCME	Carolinas Center for Medical Excellence
CDC	Center for Disease Control and Prevention
CDE	Certified Diabetes Educator
CHC	Community Health Center
DAC	Diabetes Advisory Council
DHEC	Department of Health and Environmental Control
DSC	Diabetes Initiative of South Carolina
DM	Diabetes Mellitus
ED	Emergency Department
ESRD	End Stage Renal Disease
HbA1c	Hemoglobin A1c
HPSA	Health Professional Shortage Areas
IDDM	Insulin-Dependent Diabetes Mellitus
LEA	Lower Extremity Amputation
MUA	Medically Underserved Areas
MUSC	Medical University of South Carolina
NCHS	National Center for Health Statistics
NIDDM	Non-Insulin-Dependent Diabetes Mellitus
OCDEE	Office of Chronic Disease Epidemiology and Evaluation
OQUIN	Outpatient Quality Improvement Network
ORS	Office of Research and Statistics
REACH	Racial and Ethnic Approaches to Community Health
PHSIS	Public Health Statistics and Information Services
SC DPCP	South Carolina Diabetes Prevention and Control Program
SCPHCA	South Carolina Primary Health Care Association
VA	Veterans' Affairs
WF	White Female
WM	White Male
YPLL	Years of Potential Life Lost

## Key Findings

### *Chapter One: Overview of Diabetes*

- An estimated 6.7% of South Carolinians have been diagnosed with pre-diabetes.
- Diabetes prevalence has increased by 50% in ten years and 70% in 20 years.
- Diabetes prevalence in African American males has increased 168% in 20 years, from 5.4% in 1990 to 13.9% in 2010.
- Diabetes prevalence increased by 125% in 10 years in the 18-44 age group.
- The number of infants born to mothers with gestational diabetes has doubled in the past 20 years.

### *Chapter Two: Diabetes Management and Control*

- The number of physicians who treat patients with diabetes have increased dramatically in the past 15, years, but have not kept up with the increase in patients with diabetes.
- The Certified Diabetes Educators are clustered in counties with the lowest diabetes prevalence and Emergency Department usage.
- At least 65% of South Carolina residents with diabetes are getting at least two HbA1c tests annually.
- African American females are 40% more likely to check their blood glucose daily than African American males.
- More than 50% of people with diabetes in South Carolina have attended a diabetes self-management class.
- Only about 40% of people in South Carolina with diabetes on Medicare have had an HbA1c test, an eye exam and a lipid panel all in the same year.

### *Chapter Three: Diabetes Complications*

- In 2010, one in four African American inpatients and one in five White inpatients in South Carolina had a diagnosis of diabetes.
- Cases of end-stage renal disease attributable to diabetes have increased by 52% in ten years.
- Lower extremity amputation rates have decreased by 23% in the general population in the past 10 years, by 33% in African Americans overall, and by 50% in African American females, specifically.
- Emergency department visit rates for diabetes in African Americans was four times that of Whites in 2011.

### ***Chapter Four: Health Care Costs***

- The total charges for diabetes and diabetes related inpatient and emergency department visits in 2010 was \$4.2 billion. Loss of productivity due to diabetes is estimated at \$16.8 billion annually.
- Inflation-adjusted hospitalization charges for diabetes as a primary diagnosis have almost doubled in 20 years.
- Inflation-adjusted charges for diabetes emergency department visits have increased five-fold since 1996, the first year data was available.

### ***Chapter Five: Mortality***

- Diabetes mortality has decreased by 28% in 10 years.
- Diabetes mortality has decreased by 40% in African American females.
- Diabetes mortality in African Americans is about three times that of the White population.
- In some counties, African American mortality from diabetes was five times that of Whites.
- African Americans have three times as many years of productive life lost due to diabetes as Whites.
- Perinatal mortality (death during pregnancy, delivery, or the first 7 days of life) is 40% higher in mothers with diabetes.

## Introduction

### *Diabetes as a Major Public Health Problem*

Diabetes is a serious disease, which often leads to complications, such as blindness, kidney failure, heart attacks, strokes, and amputations. High blood pressure and abnormal cholesterol levels are frequent. Diabetes has an immense impact on public health and medical care. In South Carolina medical costs rise with increased duration of the disease, and lifespan is shortened by 5-10 years in most patients.

In 2011, diabetes affected 25.8 million people in the United States with 7 million undiagnosed cases (CDC, 2011). In terms of racial and ethnic disparity, the outlook becomes more dismal, as racial and ethnic minorities are disproportionately affected and are more likely to have complications than their White counterparts, especially when they are unable to access the health care system for management and care (Lavery, et.al., 1999). Approximately 450,000 South Carolinians are affected by diabetes, many of who were still undiagnosed in 2010. One of every five patients in a South Carolina hospital has diabetes, and one in every ten visits to a South Carolina emergency room is diabetes related. The total charges for diabetes and diabetes-related hospitalizations and emergency room visits were over \$4.2 billion in 2010.

Diabetes is the seventh leading cause of death in South Carolina, directly or indirectly claiming more than 3,000 lives each year, and the fifth leading cause of death in African Americans, claiming about 1,200 African American lives each year. Most diabetes deaths occur in persons over age 60. Minorities, predominantly African Americans, experienced a substantially higher death rate and more years of potential life lost than Whites. The racial disparity in mortality has widened over the past 10 years. The racial disparity is narrowing in diabetes prevalence, primarily, because the prevalence in the White population is increasing.

### *Types of Diabetes Mellitus*

Diabetes is a disease in which the body does not produce or properly use insulin, a hormone that is needed to convert sugar, starches, and other food into energy needed on a daily basis. Genetics, obesity, and lack of exercise play a vital role in the development of diabetes.

**Type 1 diabetes** was previously called insulin-dependent diabetes mellitus (IDDM) or juvenile-onset diabetes. Type 1 diabetes develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin that regulates blood glucose. To survive, people with type 1 diabetes must have insulin delivered by injection or a pump. This form of diabetes usually strikes children and young adults, although disease onset can occur at any age. In adults, type 1 diabetes accounts for approximately 5% of all diagnosed cases of diabetes. Risk factors for type 1 diabetes may be autoimmune, genetic, or environmental related. There is no known way to prevent type 1 diabetes. Several clinical trials for preventing type 1 diabetes are currently in progress or are being planned.

**Type 2 diabetes** was previously called non–insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes. In adults, type 2 diabetes accounts for about 90% to 95% of all diagnosed cases of diabetes. It usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce it. Type 2 diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity. African Americans, Hispanic/Latinos, American Indians, and some Asians and Native Hawaiians or Other Pacific Islanders are at particularly high risk for type 2 diabetes and its complications. Type 2 diabetes in children and adolescents, although still rare, is diagnosed more frequently among American Indians, African Americans, Hispanic/Latinos, and Asians/Pacific Islanders.

**Gestational diabetes** is a form of glucose intolerance diagnosed during pregnancy. Gestational diabetes occurs more frequently among African Americans, Hispanic/Latino Americans, and American Indians. It is also more common among obese females and females with a family history of diabetes. During pregnancy, gestational diabetes requires treatment to optimize maternal blood glucose levels to lessen the risk of complications in the infant (Centers for Disease Control Division of Diabetes Translation, 2011).

### ***Purpose of the Report***

This report is a description of the impact of diabetes, including trends, disparities, morbidity, mortality, and costs. Information presented here is intended to:

- assist health care professionals and family members of persons with diabetes to understand more fully the scope of the disease in our state;
- describe progress made in recent years with patient, physician, and other health provider education, and attempts to improve access to high quality self-management training for persons with diabetes; and
- identify continuing needs and opportunities for diabetes control in South Carolina.

### ***How the Report is Organized***

The report is divided into five chapters, each with an introduction. The Introduction discusses how the report is set up, reviews the different types of diabetes and their definitions, and provides an overview of the Healthy People Objectives (USDHHS 2012a).

**Chapter One** is an overview of diabetes prevalence. It includes state and national prevalence statistics. State level information includes pre-diabetes and gestational diabetes as well as age at diagnosis. Chapter One also includes the risk factors for diabetes.

**Chapter Two** discusses diabetes management and control. This chapter includes issues of health care professional shortages and other access to care issues, as well as findings from the 2010 BRFSS diabetes module. This includes issues on diabetes clinical care, such as HbA1c tests, foot exams, eye exams and immunizations, as well as self-care practices such as glucose monitoring, checking feet, and attending diabetes self-management classes.

**Chapter Three** covers diabetes hospitalizations and emergency department visits. This includes hospitalizations from diabetes as a primary diagnosis, as well as diabetes-related hospitalizations, with diabetes as a secondary diagnosis. Hospitalizations from diabetes complications are also covered, including diabetic ketoacidosis, lower extremity amputations, renal disease and cardiovascular events. In addition, this chapter also addresses emergency department visits due to diabetes.

**Chapter Four** discusses cost issues. One section provides an overview of indirect costs such as loss of work time and wages and rehab costs. This information comes from the study “An Unhealthy America: The Economic Impact of Chronic Disease,” by the Milken Institute (<http://www.chronicdiseaseimpact.org>). Other cost information included in this chapter includes the direct charges for diabetes-related hospitalizations and emergency department visits and the payment source for those admissions.

**Chapter Five** covers diabetes mortality. This includes mortality due to diabetes, infant and perinatal mortality, and loss of productive life due to premature death from diabetes.

A **Technical Notes** section is found at the end, which reviews all data sources, data collection and analysis methodology.

### ***Efforts for Diabetes Prevention and Control***

The SC DHEC Division of Diabetes Prevention and Control has been funded by the Centers for Disease Control and Prevention’s Division of Diabetes Translation since 1994. In addition, in July 1994, the South Carolina Legislature established the Diabetes Initiative of South Carolina (DSC), with a Diabetes Center of Excellence at the Medical University of South Carolina (MUSC) and a governing Board, and three active councils. DSC works closely with DHEC’s Diabetes Division via its Board of Directors and Surveillance and Outreach Councils, committees, and task forces. A Ten Year Strategic Plan was implemented by DSC in 1998 and evaluated in 2009, and the results are reported in the *SC Medical Journal* (Myers, 2011). Results from successive Burden of Diabetes in South Carolina reports have been used to monitor progress of the strategic plan. ([http://clinicaldepartments.musc.edu/medicine/divisions/endocrinology/dsc/State\\_of\\_Diabetes\\_in\\_SC\\_030911\\_Final.pdf](http://clinicaldepartments.musc.edu/medicine/divisions/endocrinology/dsc/State_of_Diabetes_in_SC_030911_Final.pdf))

The South Carolina Division of Diabetes Prevention and Control is housed and managed within the South Carolina Department of Health and Environmental Control’s (DHEC) Bureau of Community Health and Chronic Disease Prevention. Through partnerships and related community and statewide interventions, the SC Diabetes Division overarching goals and objectives are to:

- prevent complications, disabilities, and burden associated with diabetes; and
- eliminate health disparities;

The division plans to accomplish this through:

- uniformed diabetes guidelines of care endorsed in the state;
- diabetes guidelines of care incorporated into clinical outcomes; and
- increasing the percent of people living with diabetes receiving standards of care.

The division's target populations are the disparate populations within our state, which include African Americans and Hispanic/Latinos as well as the elderly. The top issue is to ensure that all people with diabetes receive the recommended diabetes standards of care from their healthcare providers to support self-management, particularly in rural health settings as well as to increase resources for improved diabetes management in South Carolina.

Since a primary mission of the division has been to ensure a coordinated approach to diabetes prevention and control efforts, the division has established linkages and collaborated with key agencies and organizations across the state to access to evidence-based information and expertise to ensure we are doing all we can to reduce the burden of diabetes in our state. The DHEC Diabetes Division partnered with the REACH US: SEA-CEED Program (Racial and Ethnic Approaches to Community Health) and the Diabetes Initiative of South Carolina (DSC) to develop a statewide diabetes advisory council, which worked together to develop statewide guidelines for diabetes care and are currently working together to produce the next statewide diabetes strategic plan.

The Diabetes Division is designing a multi-year plan tailored for the characteristics of South Carolina Federally Qualified Health Centers. The goal of this initiative is to sustain health systems that support good chronic care management for people living with chronic diseases, through the institutionalization of quality improvement (QI) in clinics across the state. By reaching this goal, the Diabetes Division and key partners uphold the philosophy that creating an environmental change in the health care system that makes the delivery of high quality chronic disease care the "easy choice" for health care providers. This change in the environment will be reflected in chronic disease indicators. Improvements in such indicators will result in a reduction in complications, burden, and disability of diabetes and other chronic diseases.

By way of expanding and widening linkages, the division will continue to collaborate with other internal and external programs and agencies such as: DHEC's Bureau of Community Health and Chronic Disease Prevention, regional public health offices, and Office of Minority Health; the American Diabetes Association, the American Heart Association, the Carolina Center for Medical Excellence, the Diabetes Advisory Council of South Carolina, the Diabetes Initiative of South Carolina, the Diabetes Today Advisory Council, the Federally Qualified Health Centers, the Kidney Foundation, Local Diabetes Coalitions and Community Groups, Medicaid, the Medical University of South Carolina, rural health organizations, the South Carolina Primary Health Care Association, physicians' offices, University of South Carolina Prevention Research Center and others.

## Chapter One: Overview of Diabetes

Based on National Health and Nutrition Examination Survey (NHANES) data, the percent of undiagnosed diabetes has fallen from 50% of the total diabetes prevalence in the 1990's to about 28% in 2008, the most recent data available. The rising prevalence may be explained by the increase in the receipt of a timely diagnosis and treatment initiation, thus improving diabetes management and reducing the frequency and severity of complications and, ultimately, diabetes mortality. Randomized clinical trials, considered the highest standard of research, conclude that early and intensive pharmacological treatment reduces the risk of long-term microvascular disease.

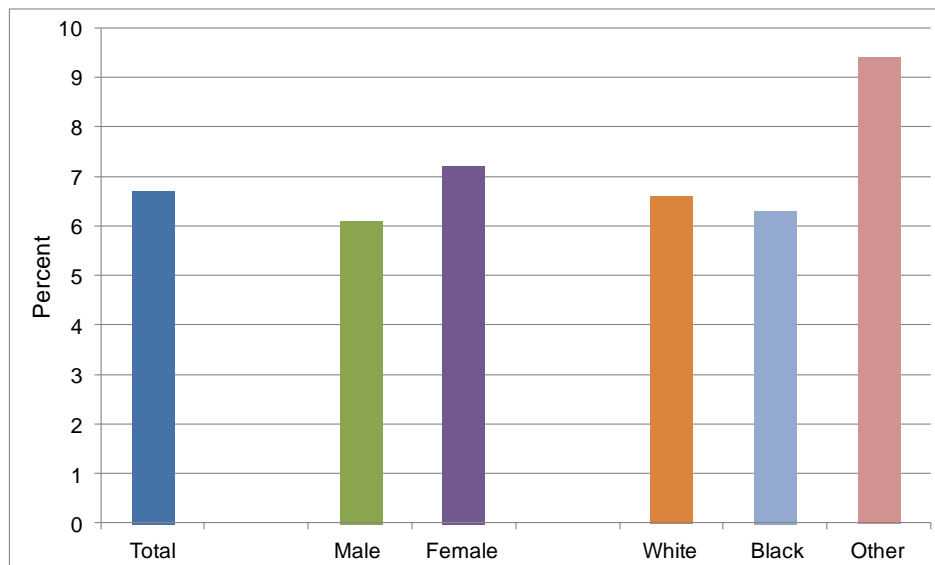
The American Diabetes Association (ADA) and Veterans Health Administration (VHA) recommend screening for diabetes at 45 years of age. On the basis of expert opinion the ADA endorses screening for diabetes in persons of any age that have a body-mass index (BMI) of 25 kg/m<sup>2</sup> or greater and have at least one additional risk factor. Those identified risk factors include but are not limited to a family history of diabetes, a history of gestational diabetes, belonging to a high-risk race or ethnic group, living with hypertension (blood pressure  $\geq 140/90$  mm Hg; or therapy for hypertension), a history of cardiovascular disease, and a physically inactive lifestyle. The U.S. Preventive Services Task Force (USPSTF) recommends screening for diabetes in adults that have a sustained blood pressure greater than 135/80 mm Hg. Despite the potential benefits, the USPSTF states that the evidence is insufficient to recommend mass screenings for diabetes (UKPDS).

### *Prevalence of Pre-diabetes*

Type 2 diabetes is prefaced by an asymptomatic stage called pre-diabetes, a condition in which blood glucose levels are higher than normal but do not meet the criteria for a diagnosis of diabetes. The diagnostic criteria defined by the American Diabetes Association for Pre-diabetes is as a fasting blood glucose between 100 and 125 mg/dl or HbA1c between 5.7 and 6.4%. (ADA 2012).

In 2010, the prevalence of pre-diabetes in South Carolina was 6.7% of the population, based on self-reported data. It was greater in females than males (Fig. 1.1). Females had almost a 20% greater prevalence of pre-diabetes than males.

**Figure.1.1. Pre-Diabetes Prevalence by Race, Gender, SC 2010**

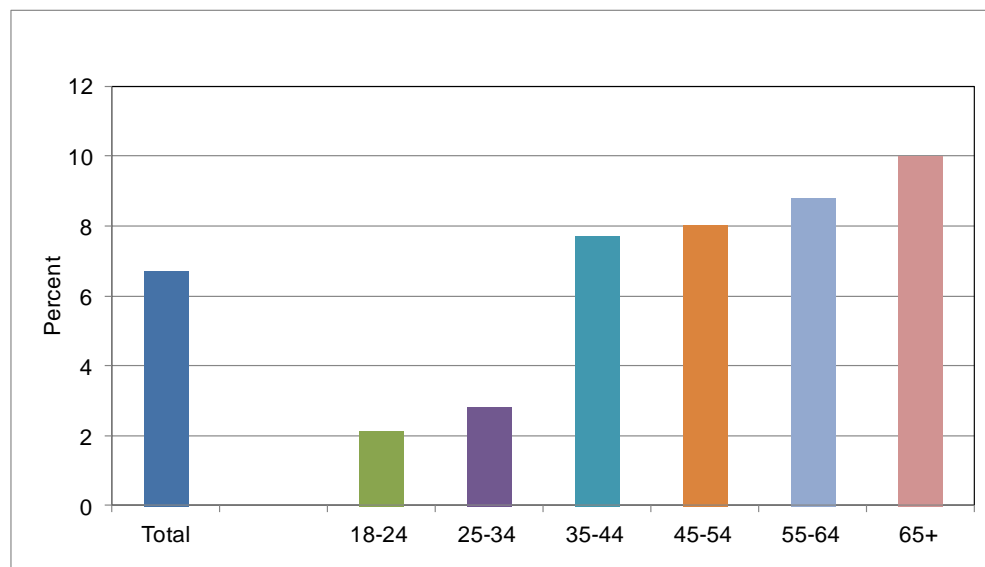


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Very little difference in pre-diabetes prevalence is observed between Whites and African Americans. The prevalence estimate of the “Other” category is 40% greater than estimates observed in the White population. The “Other” category includes Hispanic or Latino, American Indian, Asian and any other race. As with diabetes, pre-diabetes prevalence increases with age. There was a dramatic increase from the 25-34 age group to the 35-44 age group, with those over 65 having the highest prevalence (Fig. 1.2).

**Figure. 1.2. Pre-Diabetes Prevalence by Age Group, SC 2010**



Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

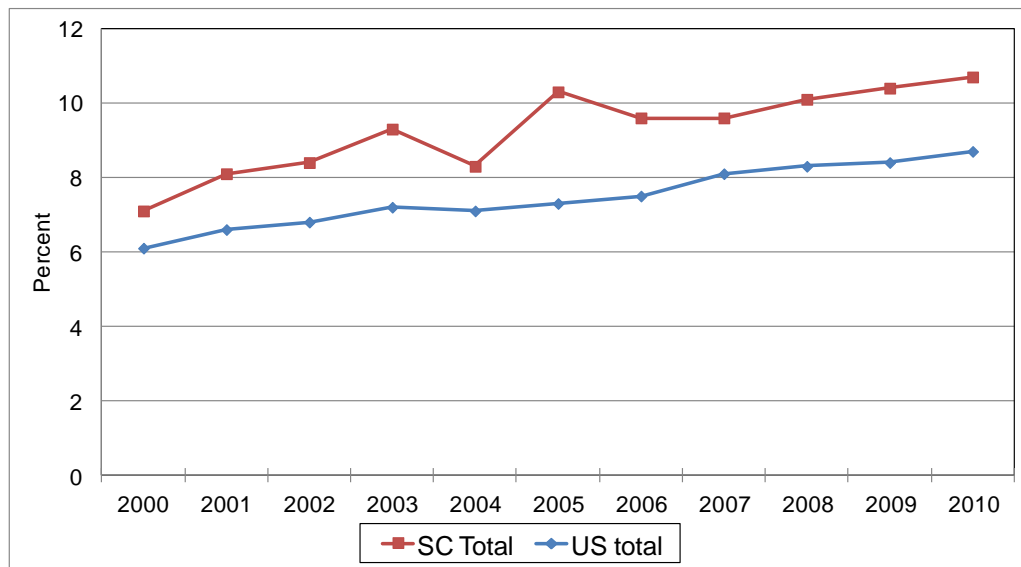
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Pre-diabetes prevalence in South Carolina is very likely under-reported. In 2005–2008 NHANES data, based on fasting glucose or HbA1c levels, over 40% of individuals had diabetes or pre-diabetes. Patient awareness of pre-diabetes is low even among those who would meet the clinical criteria for pre-diabetes. Almost one-third of the elderly had diabetes, and three-quarters had diabetes or pre-diabetes (Cowie et.al.). “Pre-diabetes” is a relatively new concept and many people who may actually have the condition may have not heard their physicians use the term “pre-diabetes”. Because awareness of pre-diabetes is still so low, it is likely that the percentage of people who are aware that they have pre-diabetes will rise as diabetes prevention efforts continue.

### ***Prevalence of Diabetes***

Over the past decade, the prevalence of diabetes in South Carolina has consistently been about 20% higher than the national rate and has increased faster than the national rate. In the past 10 years, diabetes prevalence has risen by 51% in South Carolina, from 7.1% in 2000 to 10.7% in 2010, but only by 43% nationally, from 6.1% to 8.7% (Fig. 1.3). In 2010, South Carolina had the fifth highest prevalence of diabetes in the nation, not including territories. Many states in the Southeastern United States lead the nation in high diabetes prevalence.

**Figure. 1.3. Adults Self-Reported Lifetime Diabetes Prevalence S.C. and U.S., 2000-2010**



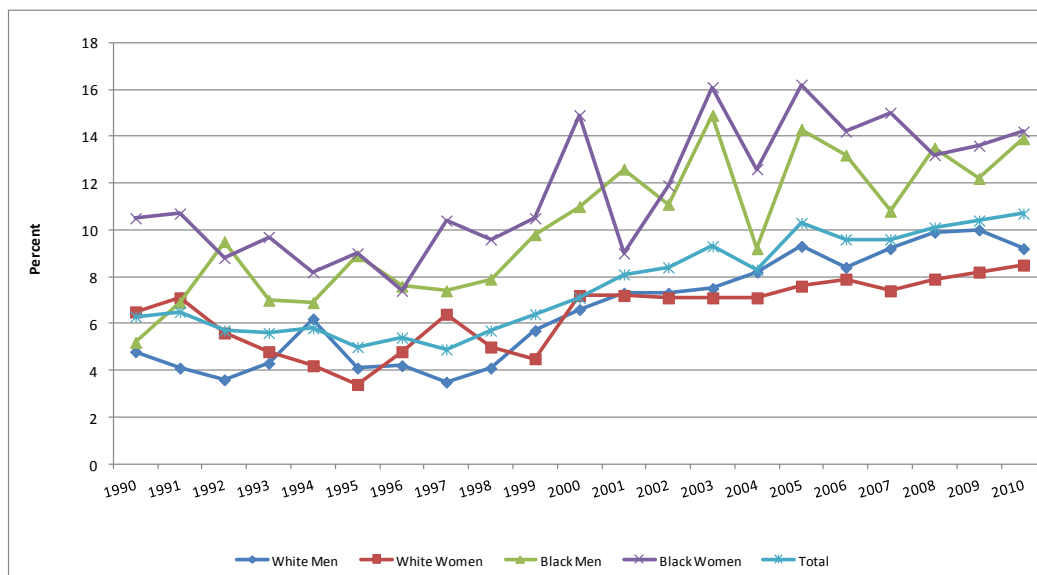
Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Figure 1.4 shows the trend of diabetes prevalence in South Carolina by race and gender. The racial disparity in diabetes prevalence is closing. Unfortunately, the gap is closing because the prevalence of diabetes in the White population has increased over the past five years, while the usually ever-increasing prevalence in the African American population seems to be leveling off.

African American females have consistently had the highest diabetes prevalence for the past twenty years. Prevalence rates have increased significantly in all race/gender groups, with the steepest rise being in the past 10 years. Overall diabetes prevalence rates in SC have risen by 51% in the past 10 years and 70% in the past twenty years, from 6.3% of the population in 1990 to 10.7% in 2010. The highest increase has been in African American males, who have experienced a 167% increase in diabetes prevalence since 1990, from 5.4% in 1990 to 13.9% in 2010. African American females had a much more modest increase in diabetes prevalence of 35% in the past 2 decades, from 10.5% in 1990 to 14.2% in 2010.

**Figure. 1.4. Adult Self-Reported Lifetime Diabetes Prevalence by Race and Gender, SC 1990-2010**

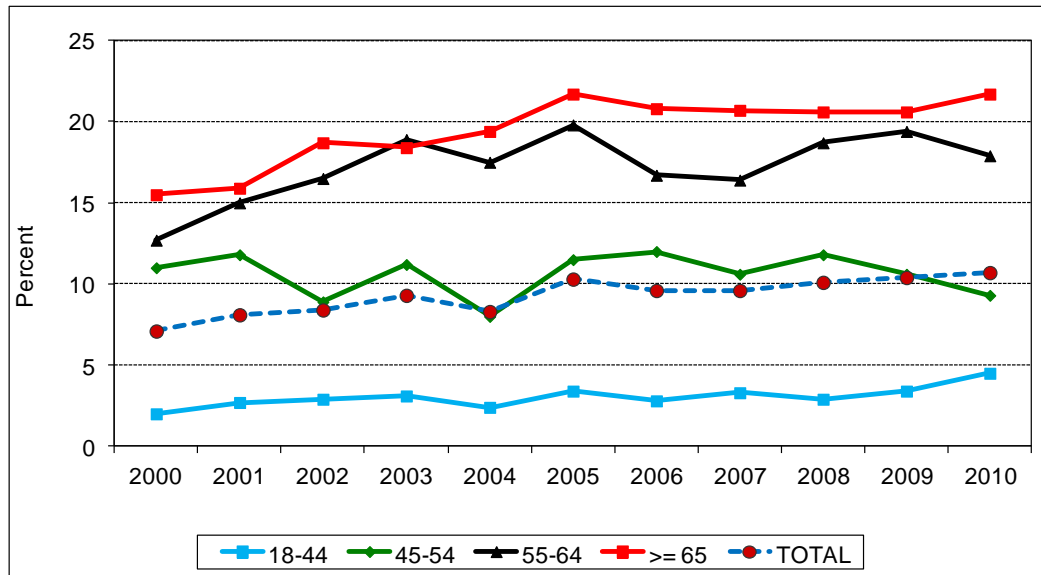


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Diabetes in South Carolina has been increasing in all age groups (Fig. 1.5). The risk of developing diabetes increasing with advancing age is well known. However, in the past 10 years, diabetes prevalence in South Carolina has been increasing more rapidly in the younger population. Diabetes prevalence in the 18-44 age group has increased by 125%, from 2.0% in 2000 to 4.5% in 2010. The prevalence of diabetes is increasing among those 55 years of age and older and this age group itself is growing. Even if the prevalence estimates had remained stable over the past ten years South Carolina's prevalence of diabetes would still have increased, because the population is also getting older at the same time. Therefore, not only is the prevalence within the age group increasing, but the size of the age group is also growing, creating simultaneous increases in the prevalence of diabetes. The 55 and older age group has increased by around 40%. Prevalence of diabetes in the 45-54 age group has actually decreased by 15%, from 11.0% in 2000 to 9.3% in 2010.

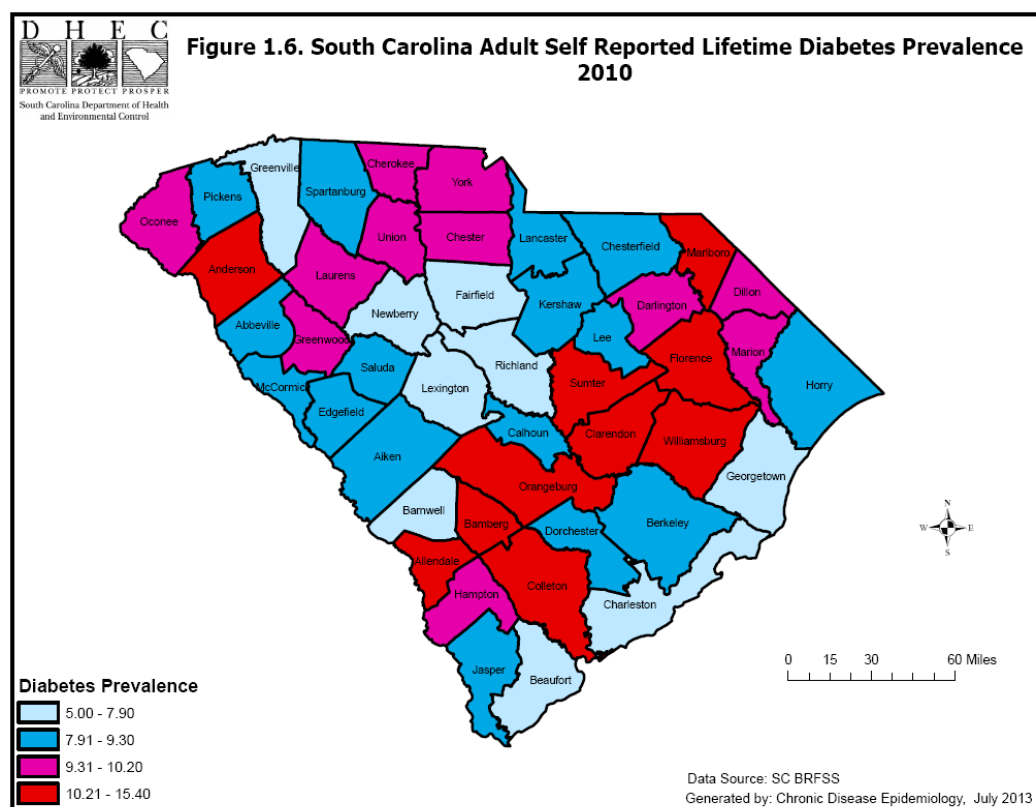
**Figure 1.5. Adult Self-Reported Lifetime Diabetes Prevalence by Age, SC 2000-2010**



Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

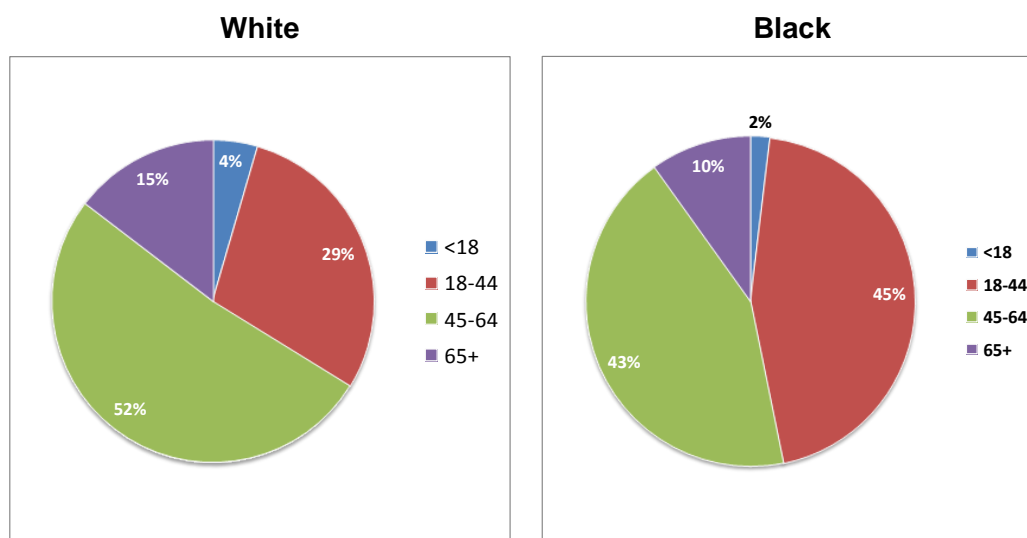
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The prevalence of diabetes by county for 2010 is illustrated in Figure 1.6. The highest rates of diabetes are found in the eastern part of the state in the area known as the I-95 corridor. This area also has consistently higher rates of obesity, hypertension, heart disease, stroke, all common comorbidities of diabetes, and tends to have higher poverty rates than other areas of the state. The lowest diabetes prevalence rates are found in the central portion of the state and along the coast.



The earlier diabetes is diagnosed, the sooner it can be brought under control and managed, therefore reducing the risk of complications. Therefore, age at diagnosis is one predictor of diabetes control and the future risk of complications. According to the 2010 BRFSS, most South Carolinians were diagnosed between 18 and 64 years of age. Less than 5% of the population was diagnosed before the age of 18, and only around 10-15% were diagnosed after age 65. Figure 1.7 shows the age at diagnosis of diabetes for both African Americans and Whites. African Americans tend to be diagnosed at a slightly younger age, with the majority, about 45%, diagnosed between ages 18 and 44. Only 29% of the White population was diagnosed between 18 and 44. The vast majority, about 52%, were diagnosed from age 45-64. The later age of diagnosis may indicate either later onset or a delay in diagnosis. In African Americans, earlier diagnosis is very possible due to the higher risks for diabetes that they have, resulting in them more likely be screened for diabetes at an earlier age.

**Figure 1.7. Age at Diagnosis of Adult Self-Reported Lifetime with Diabetes by Race, SC 2010**



Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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### ***Diabetes and Pregnancy***

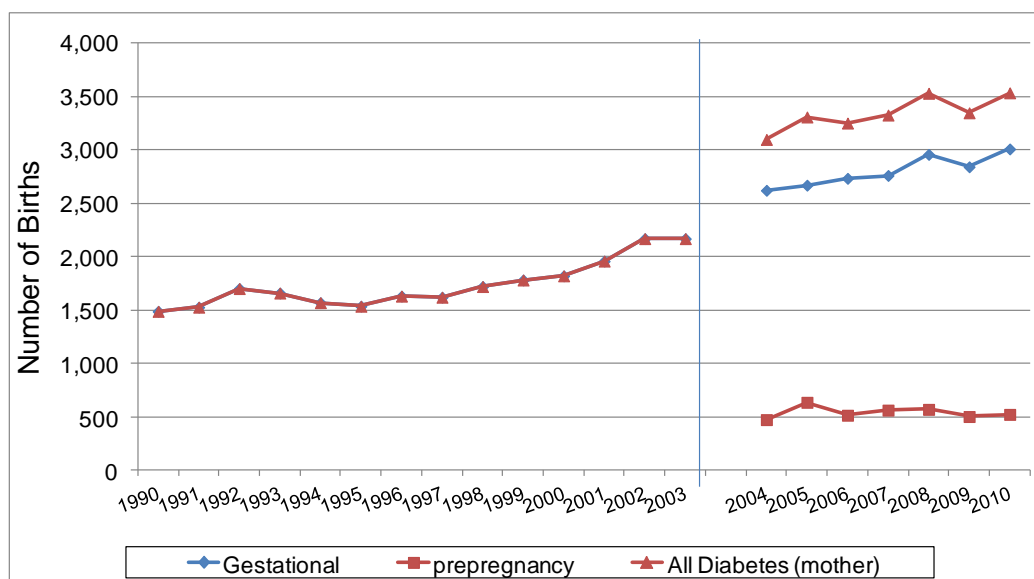
Gestational diabetes is defined as “any degree of glucose intolerance with onset or first recognition during pregnancy” (ADA 2009). The ADA recommends that females be screened for undiagnosed type 2 diabetes at the first prenatal visit. Furthermore, health care providers should screen females for gestational diabetes with an oral glucose tolerance test (OGTT) at 24-28 weeks of gestation.

Most females will return to normal glucose tolerance after delivery. However, many of these females will progress to type 2 diabetes within five years (Kim et.al, 2002). The ADA recommendation is that females who have had gestational diabetes should be screened for diabetes six to twelve weeks postpartum (ADA, 2012, Fowler, 2012) and at least every three years for the remainder of their lives. Unfortunately, postpartum screening (Kwong, et.al. 2009, Kim, et. al. 2006, Smirnakis KV, 2005) for type 2 diabetes remains low for females with a history of gestational diabetes despite the increased risk of type 2 diabetes.

Gestational diabetes is associated with infant mortality, congenital malformations and complications during labor and delivery. According to South Carolina Vital Statistics, approximately 1,700 to 1,900 pregnant females are diagnosed with gestational diabetes each year (2%-3% percent of the total number of pregnant women). Starting in 2004 with the initiation of a new birth certificate form, South Carolina Vital Statistics began recording the diabetes status of the mother as either

gestational or prepregnancy diabetes. Prior to this, only births to mothers with gestational diabetes were tracked. According to birth certificate data, the number of births to mothers with diabetes has increased dramatically over the past two decades. It has increased by 65% in the past 10 years and more than doubled in the past 20 years, from more than 1,489 births in 1990 to 3,533 in 2010. The number of births to mothers with gestational diabetes has increased from 1,489 in 1990 to 3,008 in 2010 (Fig. 1.8).

**Figure.1.8. Births to Mothers with Diabetes, SC 1990-2010**

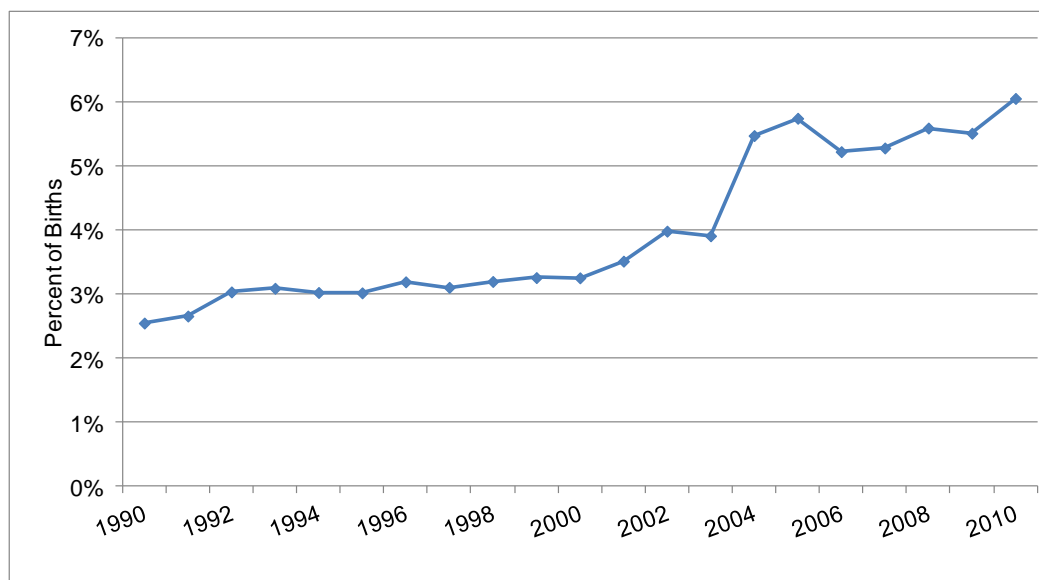


Data Source: SC DHEC Vital Records; Generated by Chronic Disease Epidemiology and Evaluation

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The number of births overall has been increasing, but births to mothers with diabetes have been increasing faster than the overall birth rate (SCAN, 2012). The percentage of births to mothers with gestational diabetes has increased by 86% in the past decade and 168% in the past twenty years (Fig. 1.9).

**Figure. 1.9. Percent of Births to Mothers with Diabetes, SC 1990-2010**



Data Source: SC DHEC Vital Records; Generated by Chronic Disease Epidemiology and Evaluation

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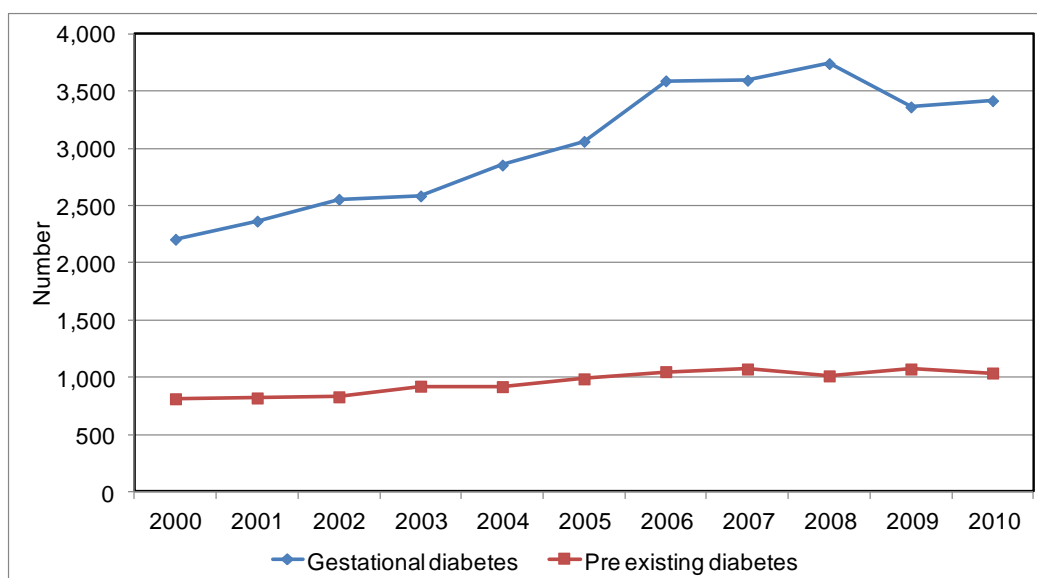
It is presumed that the state's obesity epidemic is contributing to the rise in gestational diabetes. A large proportion of the females of childbearing age in this state are overweight or obese and the likelihood of gestational diabetes onset increases with maternal body mass index (BMI). The risk of developing gestational diabetes is two, four, and eight times greater among overweight, obese, and severely obese females, respectively, compared to normal-weight females (Chu, et.al, 2007). Additionally, between 50% and 60% of overweight and obese females gain more weight during pregnancy than recommended in the 2009 Institute of Medicine guidelines (Rasmussen, et al, 2009). Both gestational diabetes and obesity are independently associated with negative pregnancy outcomes. However, the joint effect of both gestational diabetes and obesity together are associated with more adverse pregnancy outcomes than either one alone (Catalano, et.al, 2012).

The prevalence of gestational diabetes is expected to significantly increase in the years to come primarily as a result of diagnostic criteria changes announced by the International Association of Diabetes and Pregnancy Study Groups announced in 2010. The American Diabetes Association and other regional and national organizations have since adopted the criteria as a part of their standards in clinical practice. The new diagnostic criteria are broader and more inclusive. Both the International Association of Diabetes and Pregnancy Study Groups and the American Diabetes Association have announced their anticipation of significant increases in diabetes prevalence in the near future as a result of these changes. (ADA, 2012), Metger, et.al., 2010.

The number of hospitalizations for both gestational diabetes and pregnancies with prepregnancy diabetes has been growing steadily over the past 10 years. Pregnant females with

gestational diabetes are far more likely to be hospitalized than those with prepregnancy diabetes, and the gap is widening (Fig 1.10). In 2000, females with gestational diabetes were 2.75 times more likely to be hospitalized than females with existing diabetes. By 2010, they were 3.3 times more likely to be hospitalized than females with existing diabetes.

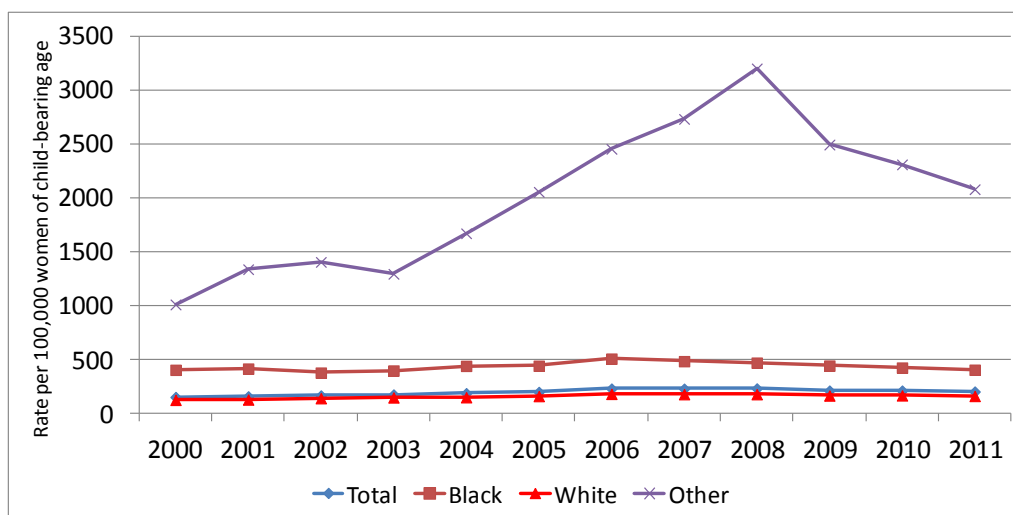
**Figure 1.10. Number of Hospitalizations for Pregnancies with Gestational and Pre-existing Diabetes, SC 2000-2010**



Data Source: SC Office of Research and Statistics, Generated by Chronic Disease Epidemiology and Evaluation April 2012

Females in minority populations are much more likely to be hospitalized for gestational diabetes than White females (Fig. 1.11). African American females with gestational diabetes are about 50% more likely to be hospitalized than White females. Females in the “Other” racial category, which are mostly Hispanic, are more than twice as likely to be hospitalized for gestational diabetes as White females. The rates for females in the “Other” racial category are high because the absolute numbers are small.

**Figure 1.11. Age-Adjusted Gestational and Pre-existing Diabetes Hospitalizations Rates by Race, SC 2000-2011**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

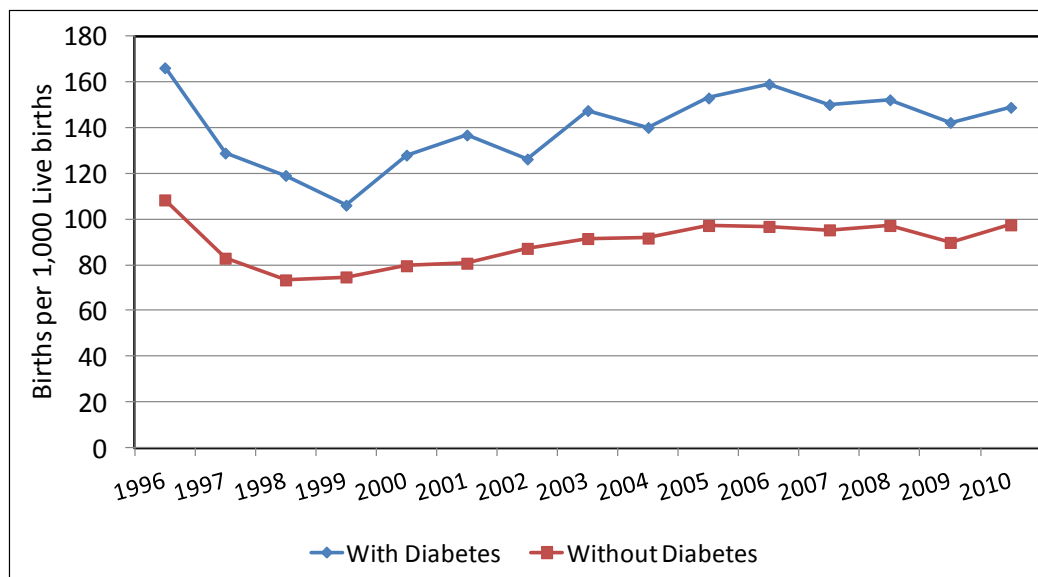
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Mothers who had diabetes during pregnancy, either prepregnancy diabetes or gestational diabetes were more likely to deliver an infant with abnormal conditions (Fig. 1.12). These Abnormal Conditions of the Newborn (item # 54 on the birth certificate) are defined in the live birth certificate as:

- Assisted ventilation required immediately following delivery
- Assisted ventilation required for more than six hours
- Neonatal Intensive Care Unit (NICU) admission
- Newborn given surfactant replacement therapy
- Antibiotics received by the newborn for suspected neonatal sepsis
- Seizure or serious neurologic dysfunction
- Significant birth injury (skeletal fracture(s), peripheral nerve injury, and/or soft tissue/solid organ hemorrhage which requires intervention)

Infants are classified as Newborn with an Abnormal Condition if any of these conditions are indicated on the birth certificate. Infants with abnormal conditions have been rising slowly since 2000, and mothers with diabetes are consistently 50% to 60% more likely to give birth to an infant with health problems than mothers without diabetes.

**Figure 1.12. Newborns with abnormal conditions among mothers with and without diabetes, SC 1996-2010**



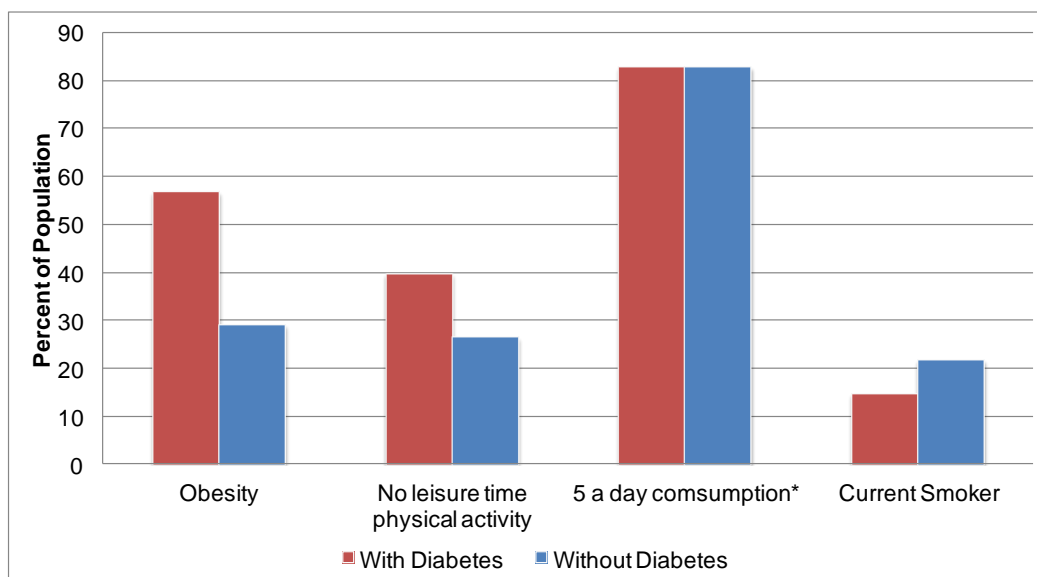
Data Source: SCDHEC SCAN; Generated by Chronic Disease Epidemiology and Evaluation

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### ***Lifestyle Risk Factors***

Obesity, physical inactivity, poor diet and smoking are all risk factors for diabetes. According to the 2010 BRFSS, South Carolinians with diabetes are more than twice as likely to be obese than those without diabetes. They are also about 50% more likely to be physically inactive than those without diabetes. There was no difference in fruit and vegetable consumption between those with and without diabetes, and people with diabetes were actually less likely to smoke than those without diabetes (Fig. 1.13).

**Figure 1.13. Lifestyle Risk Factors by Diabetes Status, SC 2009\* and 2010**



Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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A complete and detailed discussion of the status of overweight, obesity, physical activity, and fruit and vegetable consumption can be found in the DHEC Division of Nutrition, Physical Activity and Obesity's *Burden of Obesity Report*, (<http://www.scdhec.gov/health/epidata/docs/Obesity%20Burden%20Report%202011.pdf>), and in the *County Nutrition and Physical Activity Fact Sheets* (<http://www.scdhec.gov/health/chcdp/obesity/data.htm>).

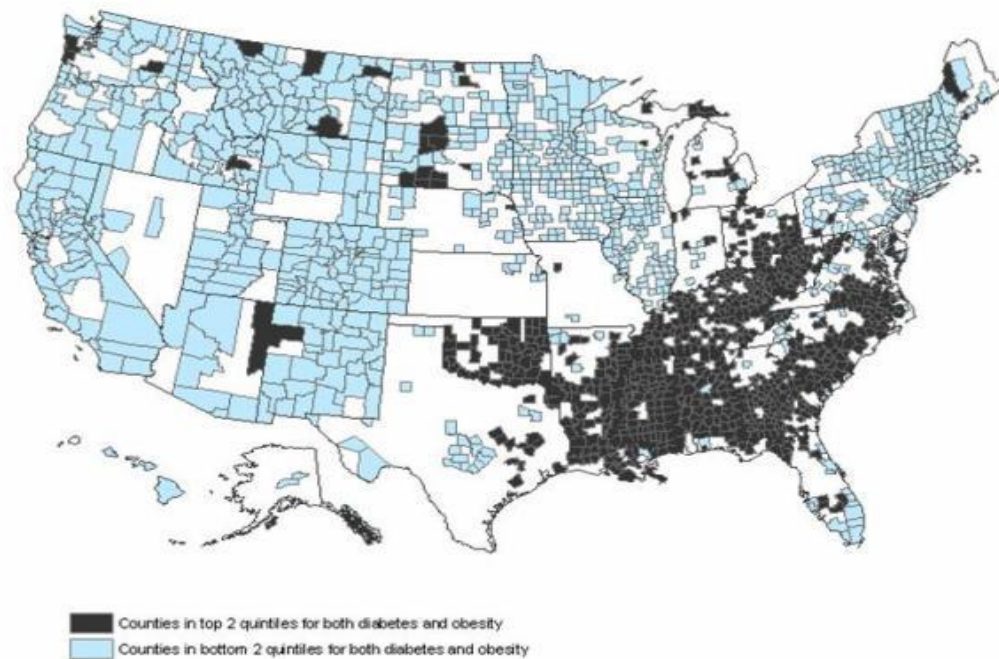
The state of being overweight or obese is a well established risk factor for type 2 diabetes (Narayan, et.al, 2007). County-level estimates of age-adjusted rates of self-reported diagnosed diabetes range from 3.7% to 15.3 % in the United States (Fig. 1.14). County-level estimates of age-adjusted rates of obesity range from 12.4% to 43.7% in the United States. The counties with the highest prevalence of both obesity and diabetes were found in Mississippi and Alabama. The counties with the lowest prevalence were found in Colorado, Wyoming and Utah. Although not in the top 10 counties nationwide, almost all counties in South Carolina were in the top 20% for both diabetes and obesity prevalence. Evidence based on data from the 1999-2004 NHANES, suggests that overweight or obese adults living with diabetes are more likely to go undiagnosed than normal weight adults (Wee, et.al, 2008). Relative to normal weight adults, the adjusted odds for having undiagnosed diabetes was 50% greater in overweight adults and 37% in obese adults.

The American Diabetes Association) recommends weight loss for all overweight and obese people with or at risk for diabetes (ADA, 2012). Dietary modifications strategies are recommended for

weight loss and physical activity and as an important element of weight loss maintenance. The recommendation for people with diabetes is to perform at least 150 minutes of aerobic physical activity per week at a moderate-intensity, spread over at least three days per week with no more than two consecutive days without exercise.

Diabetes prevalence maps by state and by county in South Carolina for the past decade can be found in Appendix 3 and 4.

**Figure 1.14. County-Level Map for Diabetes & Obesity  
(2006–2008 BRFSS)**



Source: <http://www.cdc.gov/diabetes/pubs/factsheets/countylevel/estimates.htm>

### **Summary**

In 2010, for the first time, BRFSS began tracking the prevalence of pre-diabetes in South Carolina. An estimated 6.7% of South Carolinians have been diagnosed with pre-diabetes. Diabetes prevalence is currently at 10.7% and has increased by 50% in ten years and 70% in 20 years. Diabetes prevalence in African American males has increased 168% in 20 years, from 5.4% in 1990 to 13.9% in 2010. Diabetes prevalence increased by 125% in 10 years in the 18-44 age group. The number of infants born to mothers with gestational diabetes has doubled in the past 20 years. These increases in prevalence may be attributed to several factors: a growing prevalence of obesity, an aging population, and an increase in diagnosis. The percent of undiagnosed population decreased from about 50% of the diagnosed population in 1990 to about 28% in 2010 (NHANES).

## Chapter Two: Diabetes Management and Control



*Roy Bryan is a 61-year-old DSME client referred by his physician in 2010. He attended the full series of DSME classes in Colleton County. After attending the class session on Long-Term Complications, he started explaining to the class how he suffered with severe neuropathy in his lower legs and both feet. He stated that he had learned so much about his diabetes care in the classes that he felt if he had been given the opportunity to have the education many years earlier, the neuropathy could have been delayed or prevented with proper nutrition and medication therapy. Since he*

*attended the classes, he and his physician have adjusted his medication regimen using some of the newer diabetes medications that he learned about in classes. He stated that with the nutrition education he received, he has been able to lose about 22 pounds and his blood glucoses are well controlled at this time. He is grateful for the opportunity to have the DSME classes held in his home county so he did not have to travel out of the county for the services. With his limited financial resources, he could not have afforded to attend the classes if they had been out of town.*

Diabetes can occur in any population, and all people with diabetes need education to manage this disease. Self-management training is a popular, evidence-based strategy for building people's knowledge, increasing their skills, setting healthy goals, and maintaining behavior changes.

### **Diabetes Health Professionals**

#### **Physicians**

Physicians play important roles in health care for diabetes. Table 2.1 lists the number of Physicians in those specialties most involved with diabetes care (ORS). The table also lists ratios of patients to physician (i.e. number of people with diabetes served by one physician of that specialty). Using the figure of 150,500 persons with diabetes in South Carolina in 1995 and 378,000 in 2010 gives one a sense of the relative scarcity of physician care available to patients with diabetes.

**Table 2.1. Licensed Health Professionals in SC: Physicians by Subspecialty Who Care for Patients with Diabetes**

Physician Specialty Area	1995		2010		Percent Change In Patient Caseload
	# of MDs in the state	Patients with Diabetes / Physician	# of MDs in the state	Patients with Diabetes / Physician	
Family/General Practice	747	215	1,551	244	13.4%
Internal Medicine	394	407	1,128	335	-17.7%
Endocrinology	11	14,591	57	6,631	-54.6%
Cardiology	119	1,349	322	1,174	-13.0%
Nephrology	43	3,733	126	3,000	-19.6%
Neurology	54	2,972	137	2,759	-7.2%
Ophthalmology	177	907	282	1,340	47.8%

Data source: ORS

The caseload (patients per physician) for physicians who routinely treat patients with diabetes has changed radically in the past 15 years. The caseload for family/general practice physicians, who provide most primary care for patients with diabetes, has increased by 13% since 1995. Although the number of family physicians has doubled, the diabetes population has been rising at a faster rate. The caseload for internal medicine has dropped by 20%, due to an almost three-fold increase in the number of internists since 1995. The caseload for endocrinologists has dropped by 55% since 1995, although it is still huge, with more than 6,600 patients with diabetes for every endocrinologist in the state. This indicates that patients at high risk and in need of care by an endocrinologist might have difficulty getting a timely appointment. The numbers of nephrologists have tripled and neurologists have more than doubled in the past fifteen years, but have just barely kept up with the demand, with only slight reductions in the number of patients per physician. The number of ophthalmologists has increased, but has not kept up with the increase in patients with diabetes, as the caseload for ophthalmologists has increased by 48%.

In addition to the number of physicians available being far less than the number needed, the geographic distribution of physicians imposes another problem for people with diabetes. Most of South Carolina's physicians are located in three major city areas; very few of them practice in the counties that have higher prevalence of diabetes.

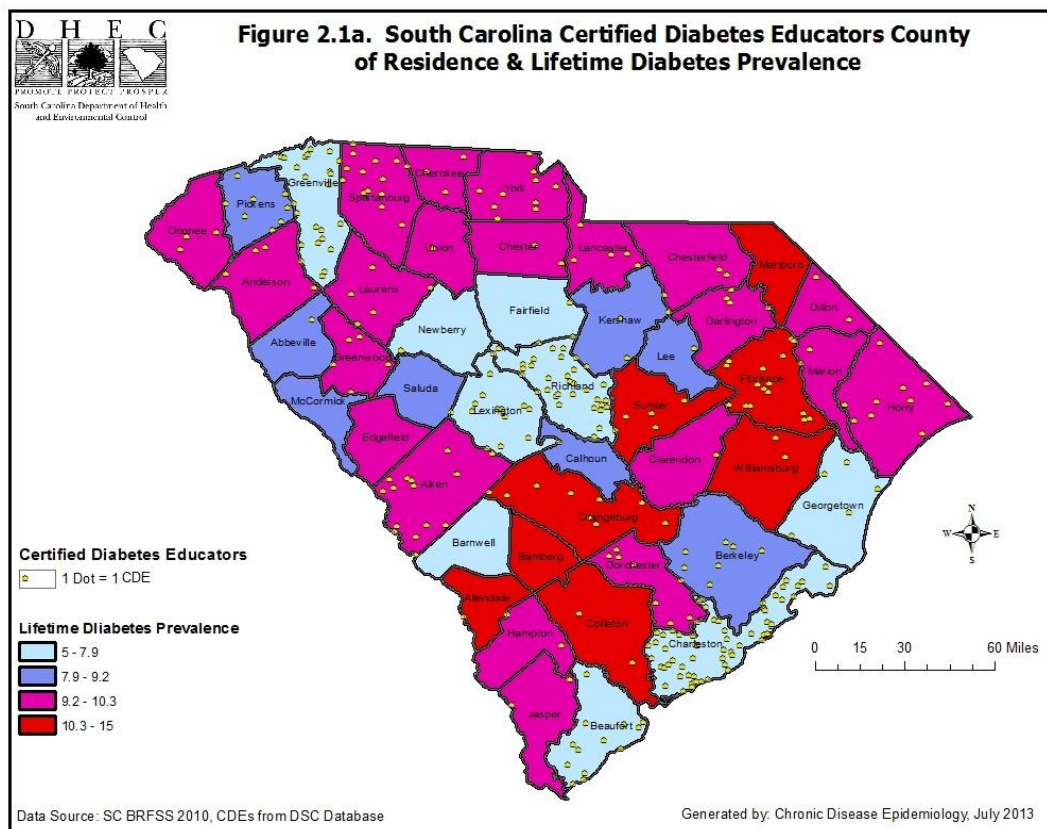
People living with diabetes in medically underserved areas throughout South Carolina are provided high-quality medical care from 19 Community Health Centers (CHC) that see more than 300,000 people annually. In 2010, the CHCs saw 312,135 people. Of those, almost one in three (32%) were covered by Medicaid, 12% by Medicare, and 40% had no insurance coverage. A total of 84% of the CHC's patient caseload were either indigent or covered by public funds. In 2010, the 20 South Carolina centers combined had 29,568 patients with a primary diagnosis code for diabetes mellitus. Additionally they delivered 75,180 visits with diabetes mellitus as the primary diagnosis code. This is 2.5 visits per diabetes patient (HRSA 2012). For more information on South Carolina's Community Health Centers visit [scphca.org](http://scphca.org).

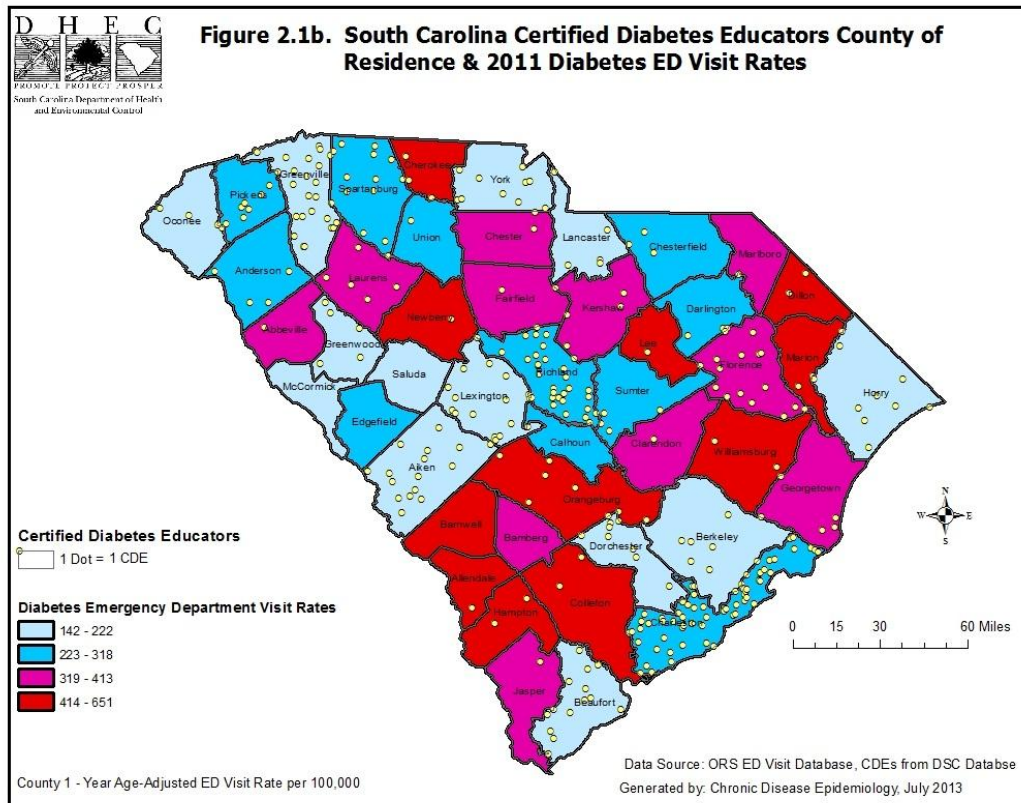
### *Certified Diabetes Educators*

Certified Diabetes Educators (CDE) work with individuals with diabetes on how to manage their diabetes as an essential component of proper diabetes care. Taking a course on diabetes, whether it be at initial diagnosis (to help people learn self-care effectively) or on a long term basis (to help them continue to maintain proper self-care practices), is a powerful tool in assisting individuals in controlling blood glucose, preventing long term complications and maintaining quality of life. In order to become a CDE, an individual must meet specific requirements involving significant professional education and professional experience, and pass a certifying exam. Once certified, CDEs are expected to:

- determine the needs of individuals with diabetes and their families;
- work with clients to design plans and goals for diabetes care;
- counsel persons with diabetes about self-care behavior and lifestyle changes; and
- perform evaluations to determine how effective education programs have been.

There were 314 CDEs in South Carolina as of 2012. On average, one CDE should serve 1,280 people with diabetes in South Carolina. As demonstrated by these maps, (Fig. 2.1a and 2.1b), the highest numbers of CDE's in South Carolina are clustered in the major population areas, and these are not the areas of the state with the highest prevalence and emergency department usage in the state. While the numbers of CDE's in the state has increased steadily, the supply is not keeping pace with demand. Among 10 counties that have the highest prevalence of diabetes, most have only one or two CDE's and two counties (Bamberg and Marlboro) do not have any CDEs.



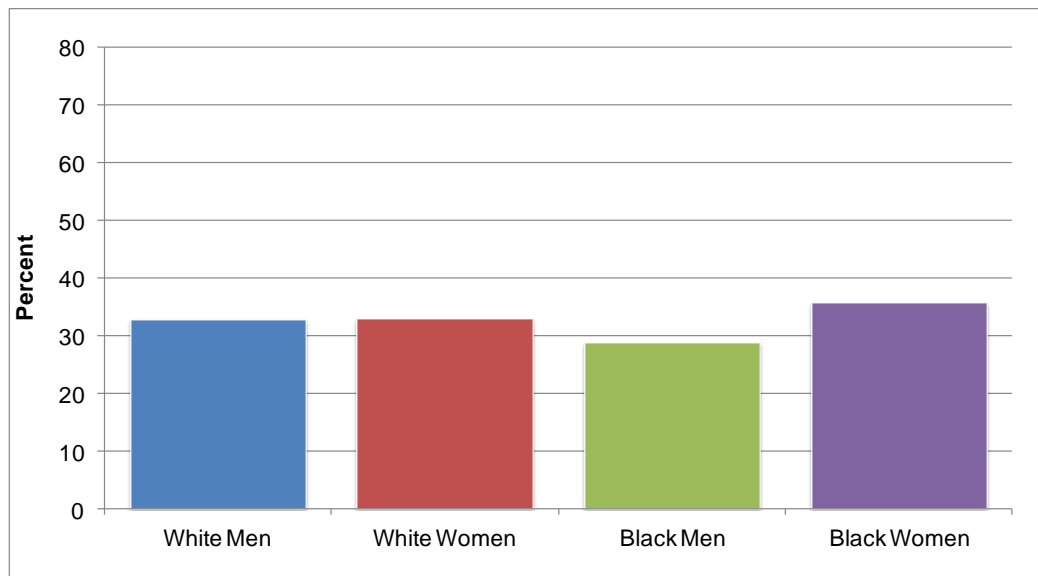


## Diabetes Management to Prevent Complications

### Behavior Risk Factor Diabetes Management Module

According to the most recent BRFSS, about one-third of people with diabetes in South Carolina are taking insulin (Fig. 2.2). Very little difference by race or gender was found in the prevalence of taking insulin, although African American females reported a slightly higher rate of insulin usage than African American males.

**Figure 2.2. Prevalence of Taking Insulin Among Adults with Diabetes by Race and Gender, SC 2010**

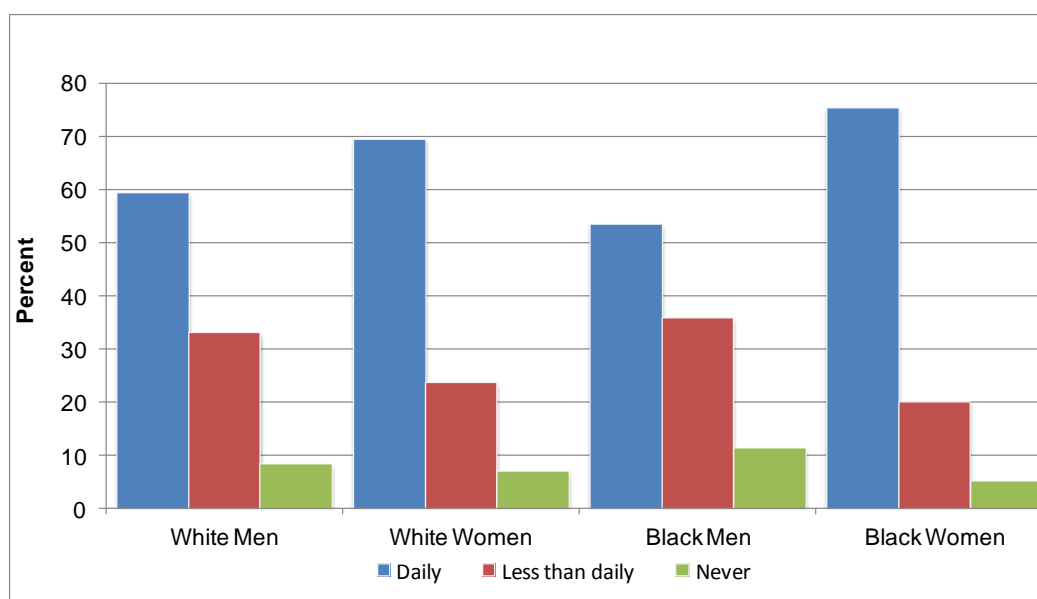


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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People with diabetes are encouraged to check their blood sugar at least daily and preferably several times a day. According to the 2010 BRFSS, African American females are the most likely of any race/gender group to check their blood sugar daily. White females are next most likely to check their blood sugar at least daily. African American males are the least likely group to check their blood sugar daily. African American males are also the most likely to have never checked their blood sugar (Fig. 2.3).

**Figure 2.3. Prevalence of Checking Blood Glucose Level among Adults with Diabetes by Race, Gender, SC 2010**

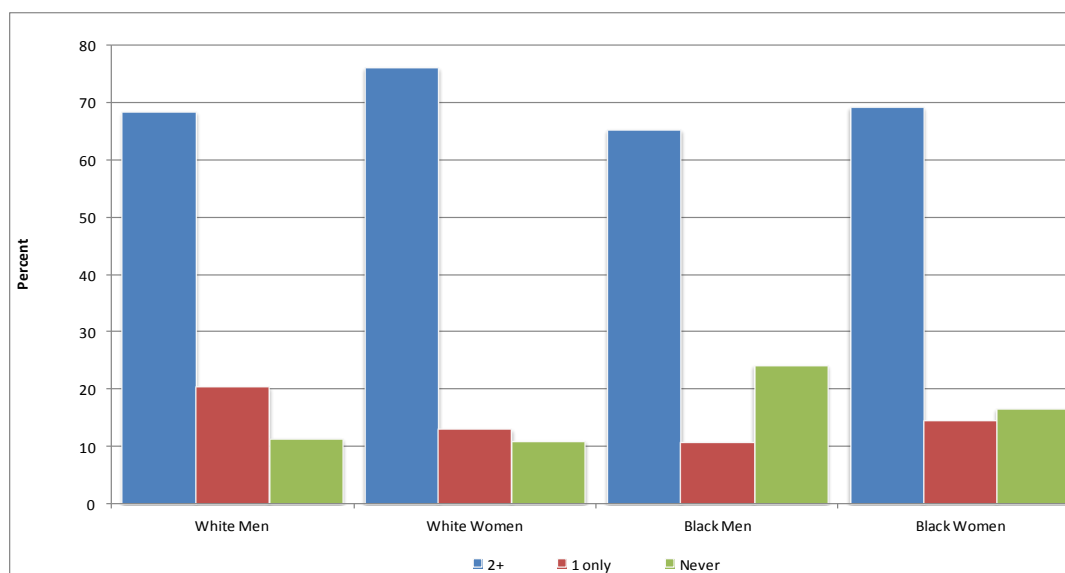


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Hemoglobin A1c (HbA1c) or glycosylated hemoglobin is a measure of average blood glucose level in the past 2-3 months. HbA1c is considered a strong predictor of diabetes complications (DCCTRG, 1993). The American Diabetes Association recommends testing HbA1c levels at least twice per year in patients who are meeting treatment goals, and quarterly in those who are not meeting glycemic goals or whose therapy has changed. The vast majority of people with diabetes have at least two HbA1c tests run each year. At least 65% of all race/gender groups have more than one HbA1c per year (Fig. 2.4). White females are the most likely to have at least two HbA1c's per year (76%), while African American males are the least likely, at 65%. For most groups, less than 10% have never had an HbA1c, except for African American males, whom one out of four report having never had an HbA1c checked.

**Figure 2.4. Prevalence of Having HbA1c Checked among Adults with Diabetes, SC 2010**



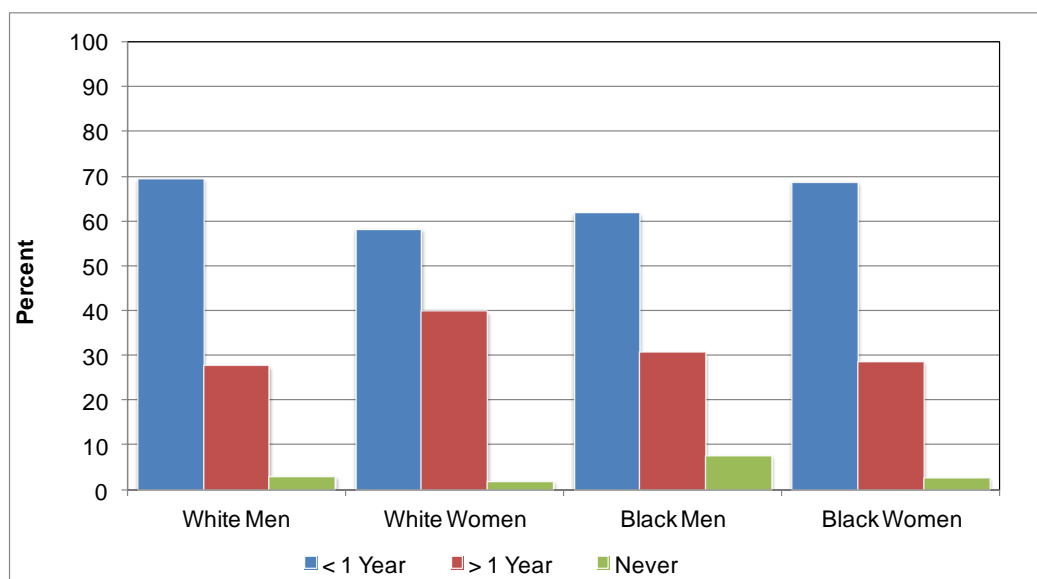
Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Diabetic retinopathy is a vascular complication of type 1 and type 2 diabetes caused by damage to the blood vessels of the retina. It is the most common cause of new cases of blindness among adults aged 20-74 years of age. Between 40 to 45 percent of Americans diagnosed with diabetes have some stage of diabetic retinopathy (National Eye Institute, 2012). Additionally, glaucoma, cataracts, and other disorders of the eye occur earlier and more frequently in people with diabetes. The ADA recommends that people with diabetes should have a dilated eye exam performed by an ophthalmologist or optometrist shortly after diagnosis of type 2 diabetes and repeated annually. However, less frequent eye exams may be justified following one or more normal eye exams among those with well-controlled diabetes.

According to 2010 BRFSS, 63% of all people with diabetes had an annual eye exam (Fig. 2.5). White females were the least likely to have had an annual eye exam and White males and African American females were equally as likely to have had an annual eye exam. Barriers to regular eye examinations include awareness of the need for routine eye examinations among both patients and providers, lack of convenient transportation for appointments, lack of clinic availability, and a shortage of eye care professionals (Ahmed, 2006).

**Figure 2.5. Prevalence of Having Eyes Examined among Adults with Diabetes by Race and Gender, SC 2010**

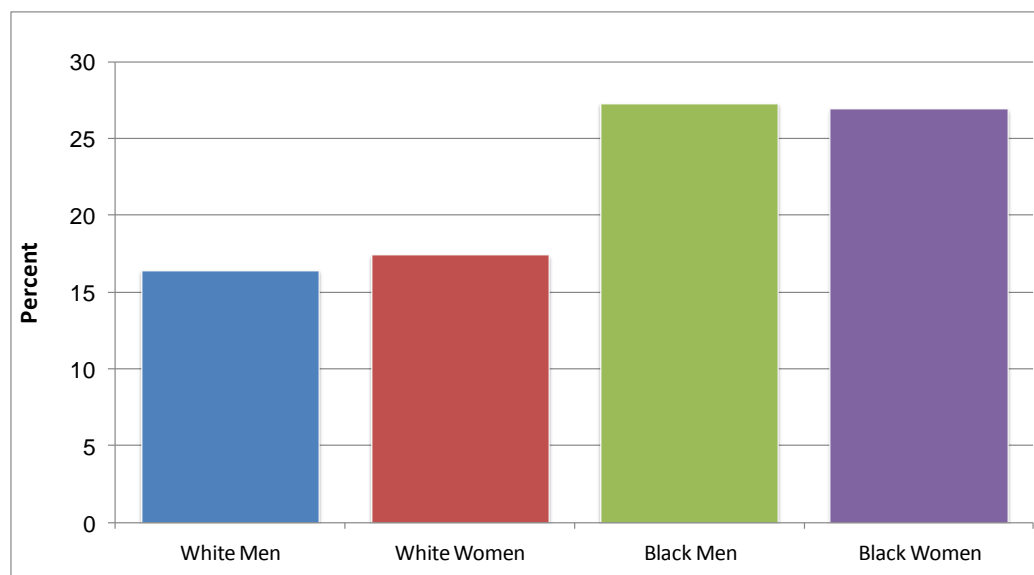


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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In 2010, African American males were the most likely of all race/gender groups to report having eyes affected by diabetes (Fig. 2.6). They were 66% more likely to have eyes affected by diabetes than White males, who had the lowest prevalence. African American females were 65% more likely than White males to have eyes impacted by diabetes. White females were about 10% more likely than White males to have eye problems due to diabetes.

**Figure 2.6. Prevalence of Eyes Being Affected by Diabetes among Adults with Diabetes by Race and Gender, SC 2010**

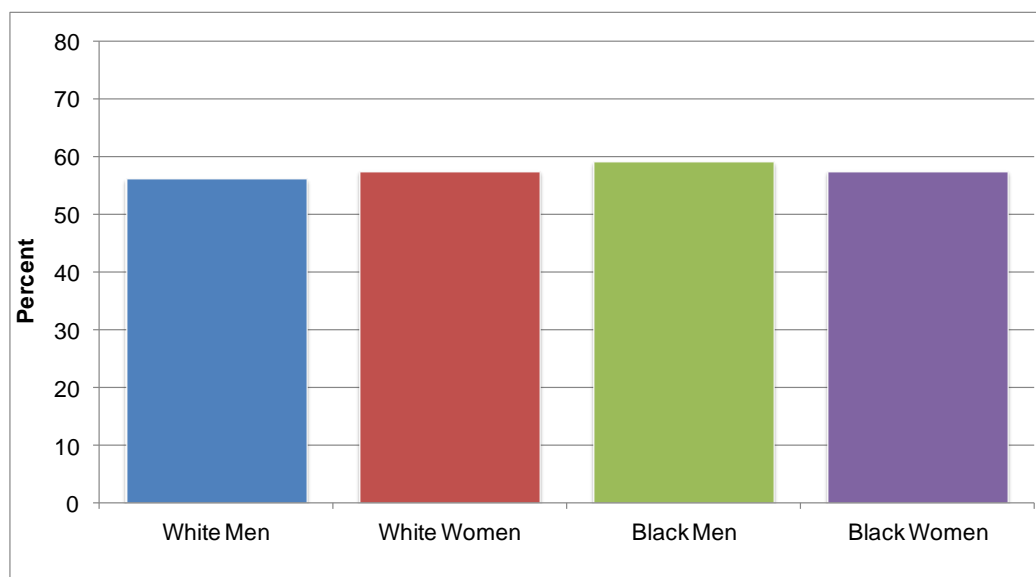


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Diabetes self-management is extremely important in reducing the risk for complications associated with diabetes. These techniques first need to be learned through diabetes self-management education, which is an integral part of the treatment plan. The seven principals of the American Association of Diabetes Educator's principles and concepts of the self-care behavior framework are healthy eating, being active, blood sugar monitoring, medication adherence, healthy coping, problem solving and complications risk reduction behaviors. Almost 60% of people with diabetes reported having taken a course for managing their diabetes. There was very little difference by race and gender (Fig. 2.7).

**Figure 2.7. Prevalence of Having Taken a Course for Managing Diabetes among People with Diabetes by Race and Gender, SC 2010**

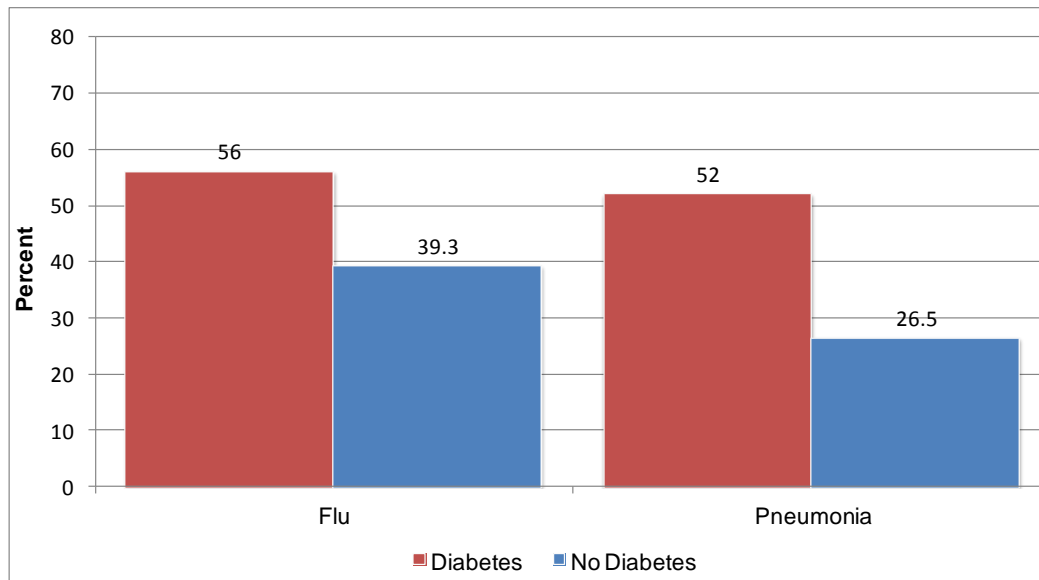


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

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Influenza and pneumonia are common yet preventable infections. They are associated with high mortality and morbidity among the elderly and in people living with chronic diseases including diabetes. Some studies have shown that the receipt of the influenza vaccine reduced diabetes-related hospitalizations by as much as 79% during period of flu epidemics (Colquhoun, et.al. 1997). The SC BRFSS data available for 2010 indicate that people with diabetes were more likely to get flu and pneumonia vaccinations than those without diabetes (Fig. 2.8). People with diabetes were about 40% more likely to get annual flu shots as those without diabetes, and were twice as likely to get pneumonia vaccines. These are included as recommended immunizations by the ADA's 2012 Standards of Medical Care as well as the hepatitis B vaccination.

**Figure 2.8. Prevalence of Receiving Flu Shot in Past 12 Months and Ever Received Pneumonia Vaccine among People with Diabetes, SC 2010**

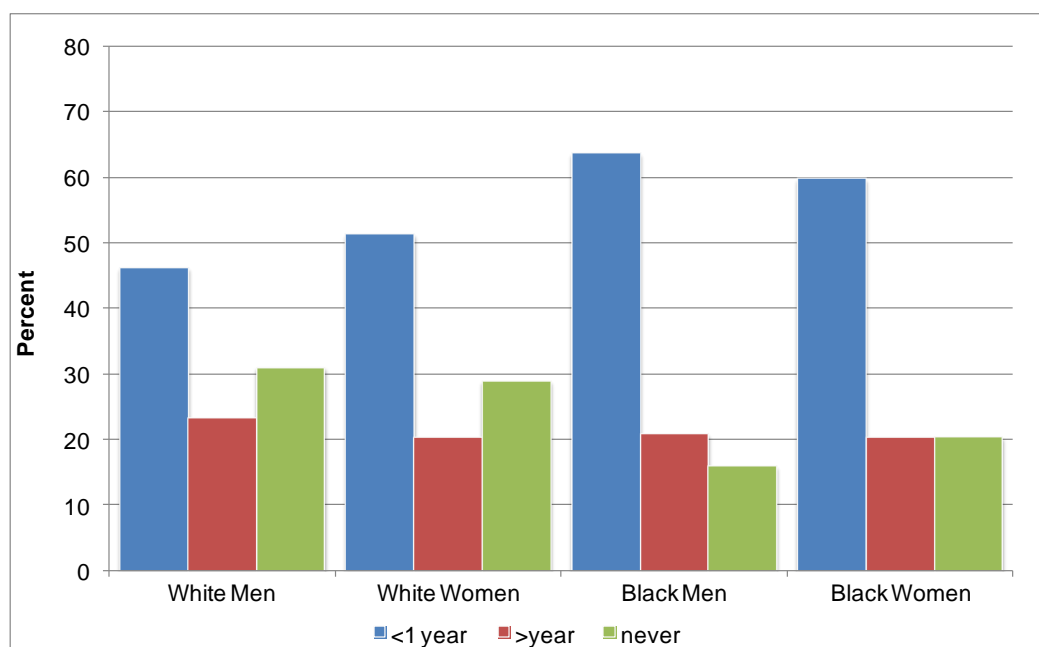


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

The ADA recommends that adults with diabetes should have checked comprehensive foot examination by a professional at least annually. In 2010, African American males were the most likely to have had their feet checked by a health professional (Fig. 2.9). White males were the least likely to have a foot exam. African American males were 40% more likely, and African American females 30% more likely to have annual foot exams than White males. African American males were the least likely to have never had a foot exam. White males were twice as likely as African American males to have never had a foot exam, and White females were 80% more likely than African American males to have never had a foot exam.

**Figure 2.9. Prevalence of Having Feet Checked by a Health Professional in the Last Year among Adults with Diabetes by Race and Gender, SC 2010**



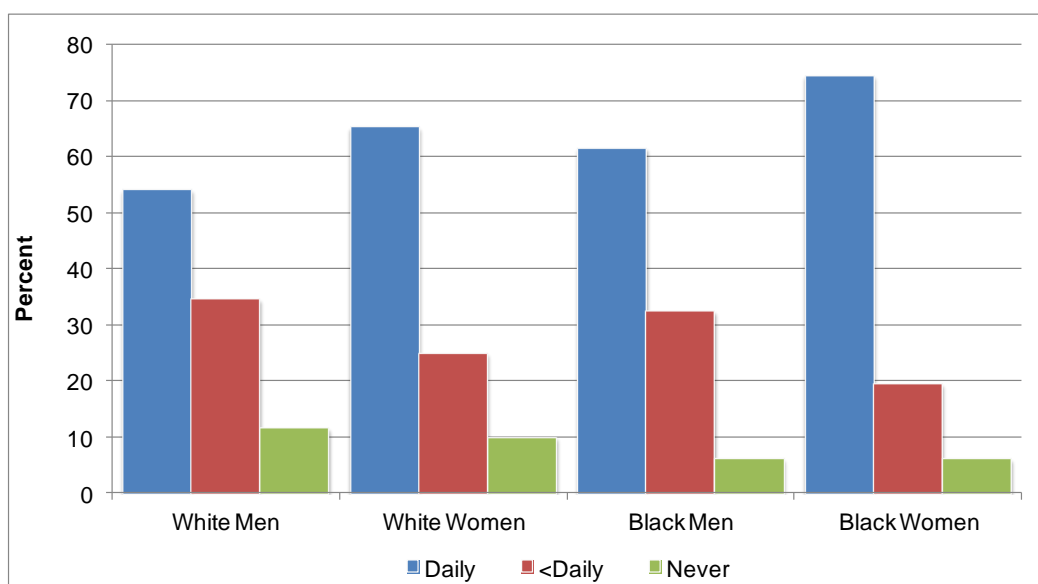
Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Checking feet daily for sores or cuts is one of the best ways of preventing foot problems, such as foot ulcers, or keeping existing problems from escalating into severe problems that require amputations. People with diabetes should be educated on the importance of daily foot monitoring and proper foot care. Proper care of the foot includes selecting appropriate footwear, and care for the nails and skin. Some people living with diabetes are physically unable to monitor their feet due to visual difficulties, physical constraints in movement, or cognitive impairment. These people require assistance from others such as family members (ADA, 2012).

South Carolina's 2010 BRFSS data indicates that African American females with diabetes were the most likely to check their feet on a daily basis (Fig. 2.10). White males with diabetes were the least likely to check their feet daily and the most likely to never have checked their feet for problems.

**Figure 2.10. Prevalence of Self-Checking Feet for Sores or Irritations among Adults with Diabetes, By Race and Gender, SC 2010**

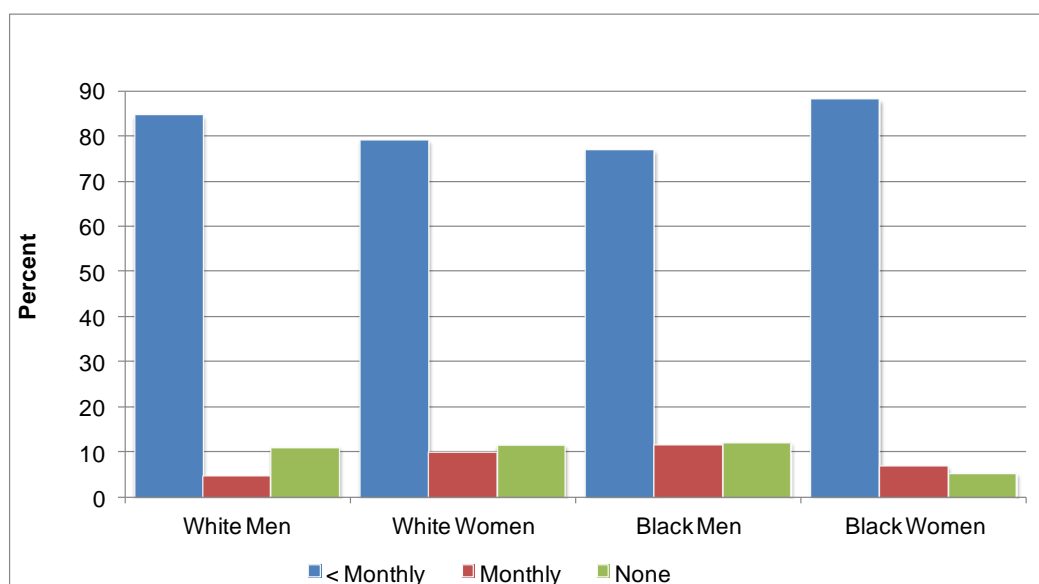


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Seeing a physician regularly is critically important for people with diabetes. At least nine out of 10 people with diabetes reported seeing their physician at least annually in 2010 (Fig. 2.11). African American females were the most likely to have visited their physicians at least annually, and White males were the least likely to have seen their physician in 2010.

**Figure 2.11. Prevalence of Seeing a Health Professional for Diabetes in Past Year by Race and Gender, SC 2010**

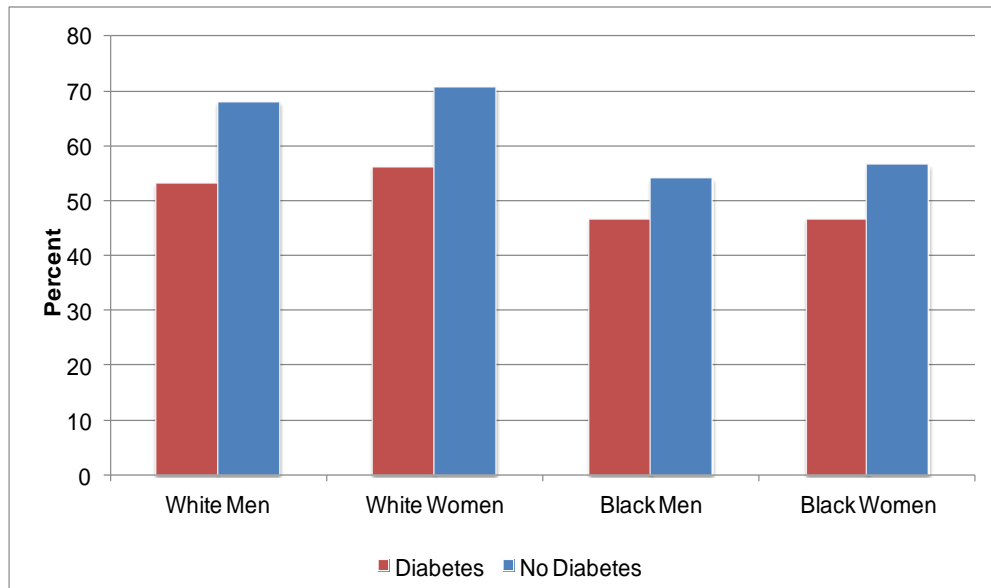


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

According to the 2010 BRFSS, people with diabetes were about 20% less likely to have visited a dentist in the past year than those without diabetes (Fig. 2.12). White females, both those with and without diabetes were the most likely race/gender group to see a dentist annually.

**Figure 2.12. Adults that have visited a Dentist, Dental Hygienist or Dental Clinic within the past year by Race and Gender, SC 2010**



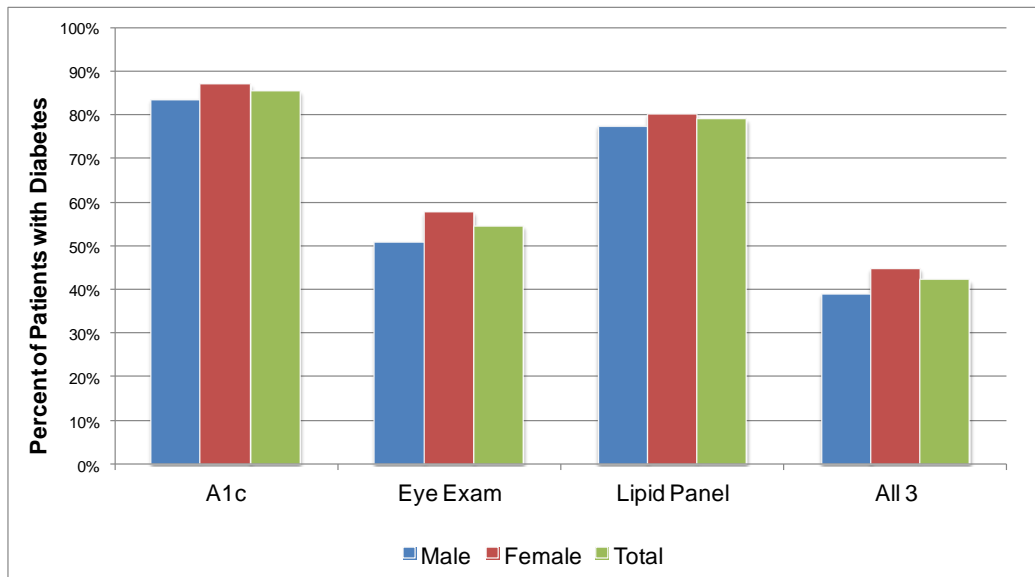
Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### *Medicare*

Medicare claims data was utilized to get a better understanding of the use of selected diabetes quality of care indicators, including getting at least one HbA1c, an eye exam and a lipid panel, or all three, annually. These were compared by gender, age, and race (Fig. 2.13-2.15). Figure 2.13 looks at the prevalence by gender. Approximately 85% of South Carolina Medicare recipients with diabetes received at least one HbA1c, 54% received an annually eye exam, and 78% received a lipid panel, but only 42% had all three in one year. Females were slightly more likely to receive each of the indicators, and about 10% more likely to receive all three than males.

**Figure 2.13. Medicare Diabetes Quality Indicators by Gender, SC 2007**

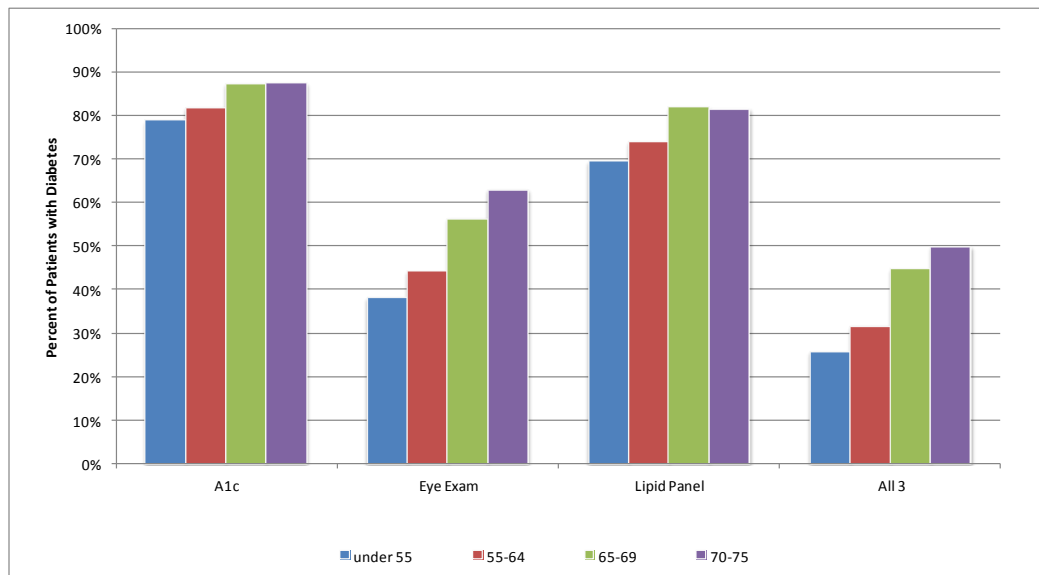


Data Source: SC Medicare claims, supplied by CCME; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Figure 2.14 shows the quality indicators by age group. For each indicator, prevalence of receiving the test increases with advancing age. The 70 and over age group were almost twice as likely to receive all three as the under 55 age group. Given that this is Medicare claims data, those under age 65 in this cohort have a disability of some kind or kidney failure in order to have qualified for Medicare. This makes them a high-risk group.

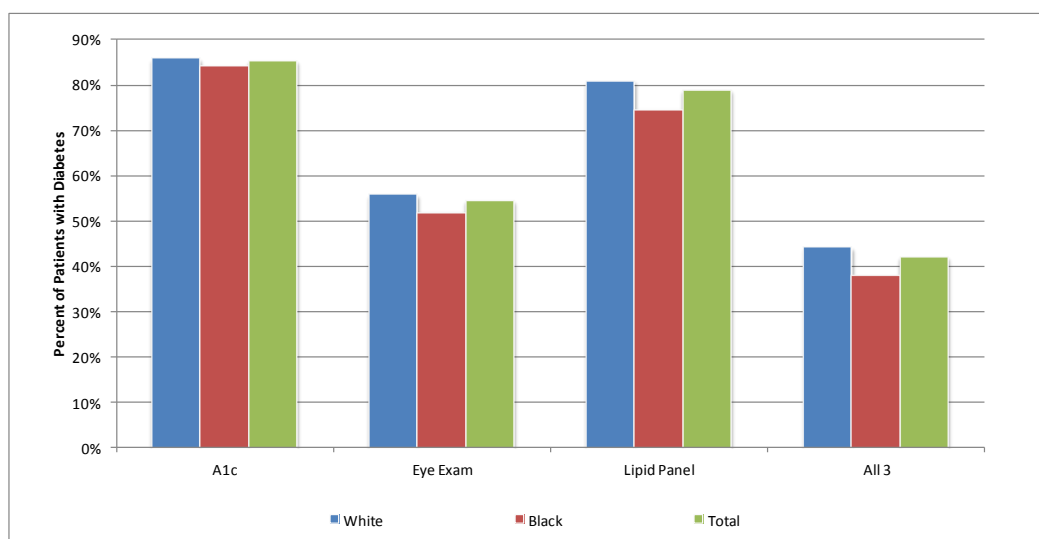
**Figure 2.14. Medicare Diabetes Quality Indicators by Age Group, SC 2007**



Data Source: SC Medicare claims, supplied by CCME; Generated by Chronic Disease Epidemiology and Evaluation, April 2012

Whites are slightly more likely than African Americans to have gotten a lipid panel or an eye exam. There was no difference in those who received HbA1cs by race. Whites were more likely to have received all three tests in one year (Fig. 2.15).

**Figure 2.15. Medicare Diabetes Quality Indicators by Race, SC 2007**



Data Source: SC Medicare claims, supplied by CCME; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

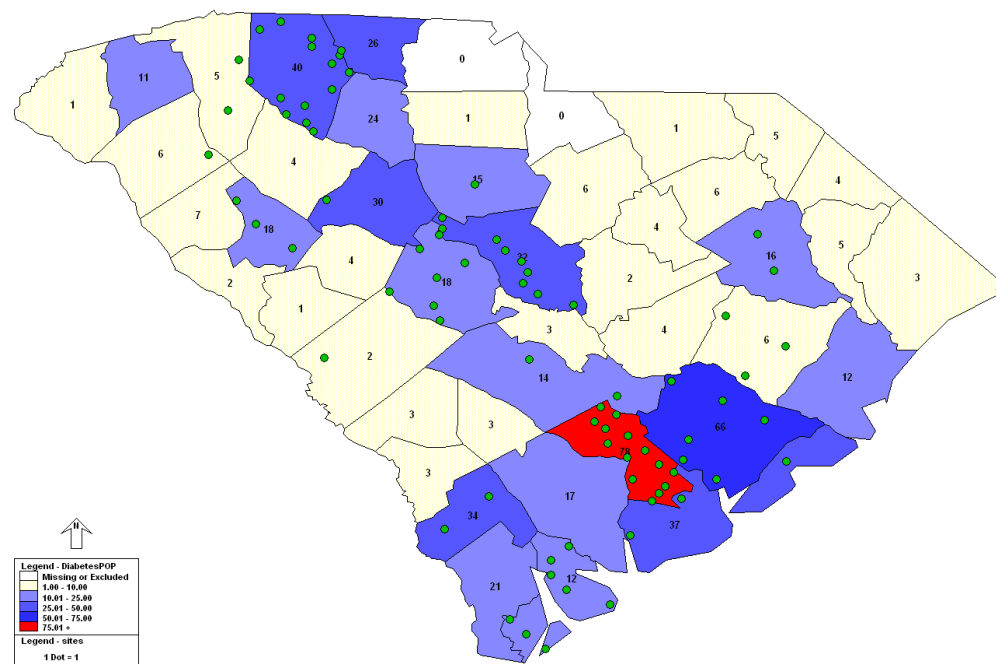
### *Outpatient Quality Improvement Network*

Outpatient Quality Improvement Network (OQUIN) is a collaborative of healthcare providers, most of whom are primary care physicians. It is built on a shared passion for serving patients in the best way possible. Active OQUIN physicians are interested in using data to improve quality and often want to participate in research (MUSC, 2012). The Outpatient Quality Improvement Network evolved from the Hypertension Initiative, which was formed in 2000 at the Medical University of South Carolina (MUSC). OQUIN is an active Practice Based Research Network and Quality Improvement Network. The purpose of the OQUIN is the prevention of chronic diseases, which began with a focus on heart and vascular health.

OQUIN uses a complementary two-component strategy to pursue its purpose; namely, healthy lifestyles and access to effective care and medications. The principal means for pursuing its purpose is a network of community-based practices that share a common commitment to improving health promotion and excellence in chronic disease prevention and management through application and sharing of evidence-based best practices. A centralized database reflecting medical summary data from adult patients at all participating practice sites provides a dynamic information management infrastructure to assist primary care physicians to monitor and optimize their cardiovascular risk factors and treatment patterns in their patients. Participating providers contribute clinical data into the database in return for practice management consultation and feedback on patient care indicators that are compared to the same indicators for the state and the rest of the network.

Figure 2.16 shows the distribution of OQUIN participating clinic sites in South Carolina and the percent of the diabetes population by county of residence represented by the OQUIN database as of 2010. The counties in yellow have less than five percent of their diabetes population represented in the database. The counties in red have more than 75% of their diabetes population represented in the OQUIN database.

**Figure 2.16. Percent of the Diabetes Population Represented by OQUIN and OQUIN Clinic Sites**

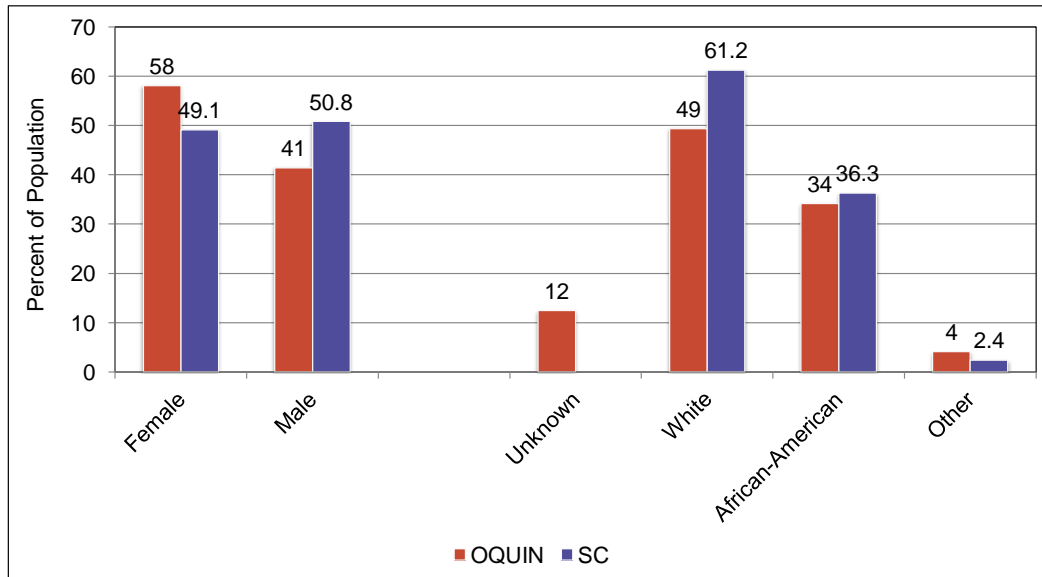


Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

The demographic breakdown is similar to the South Carolina diabetes population with respect to race and gender. The White diabetes population is slightly under-represented in OQUIN (Fig. 2.17). However more than 10% of the records had race missing or unknown, so this may account for some of the discrepancy.

**Figure 2.17. OQUIN Diabetes Patient Demographics 2009-2010**

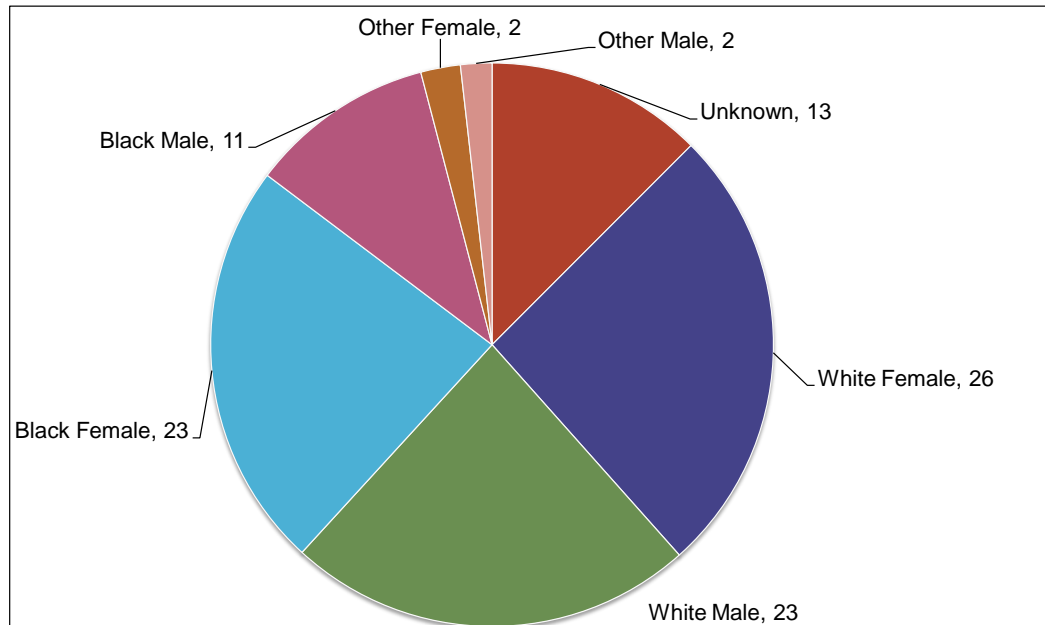


Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

The South Carolina OQUIN Diabetes population has a similar distribution of African American females, White males and White females (Fig 2.18). African American males comprise a smaller proportion of this group than African American females do.

**Figure 2.18. OQUIN Diabetes Patient Demographics by Race and Sex**

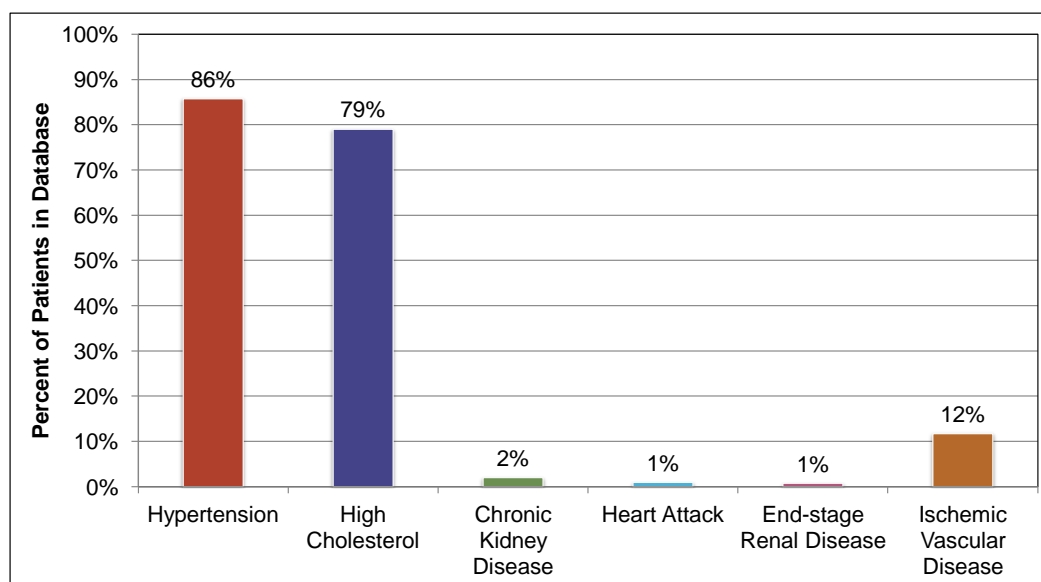


Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

Fig. 2.19 shows the comorbidities that were diagnosed in the patients with diabetes. The vast majority of these patients, more than three out of four (79%), had high cholesterol and almost nine out of ten (86%) had hypertension. The records show that 12% had ischemic vascular disease, and a very small number, less than two percent, had a diagnosis recorded of chronic kidney disease, end-stage renal disease (ESRD), or heart attack.

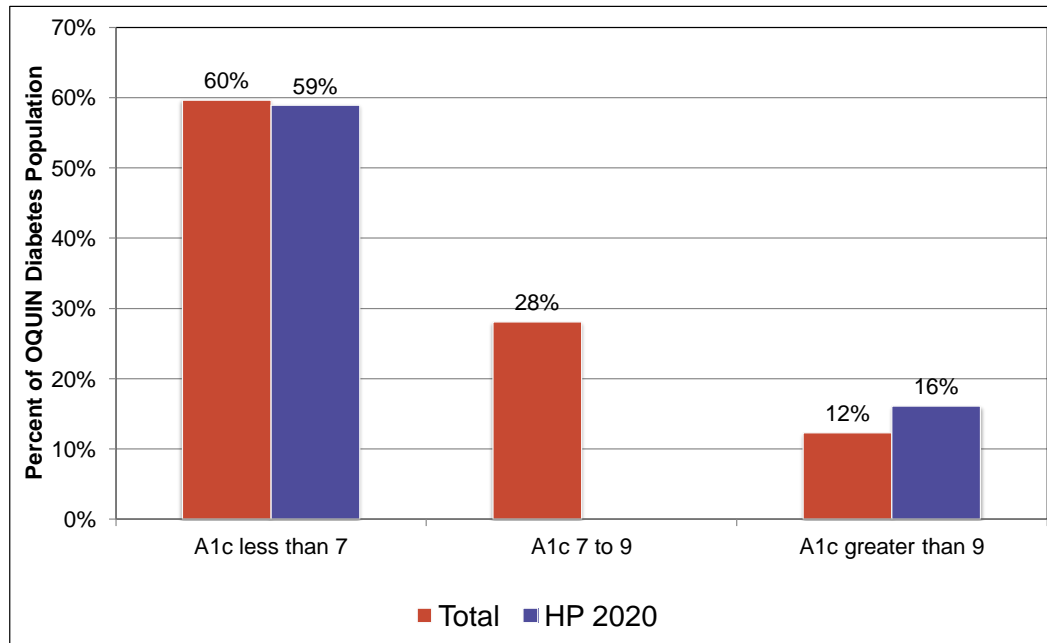
**Figure 2.19. The Prevalence of Comorbidities in the OQUIN Diabetes Population**



Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

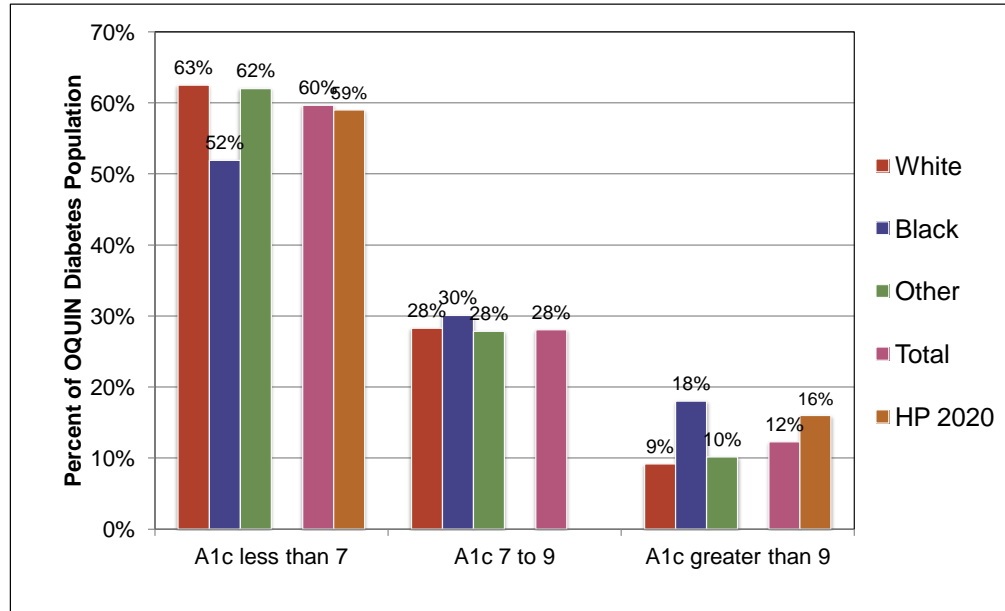
HbA1c values varied widely, from as low as 4.0% to as high as 14%. The average HbA1c was 7.5%. This was consistent through most demographic groups. However, African Americans did have a mean HbA1c of 7.8%, which was significantly different from the White population mean of 7.25%. Approximately 60% of the OQUIN diabetes patients had their diabetes under control, based on an average HbA1c of less than 7.0%. Approximately one-fourth had an average HbA1c value of 7.0% to 9.0%, and only 12% had an HbA1c more than 9.0%. (Fig. 2.20).

**Figure 2.20. Prevalence of A1c Results by Categories**

Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

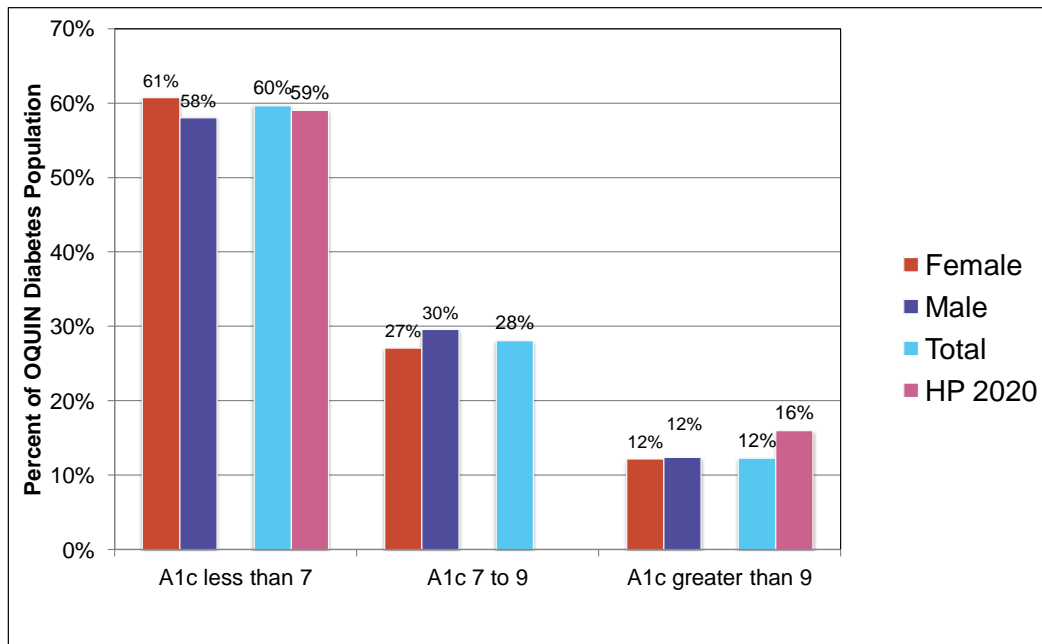
When looking at HbA1c breakdown by race, only 52% of African Americans had an HbA1c less than 7% and 18% had an HbA1c more than 9% (Fig 2.21).

**Figure 2.21. Percent of A1c Categories by Race**

Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

Very little difference in HbA1c existed between genders (Fig. 2.22).

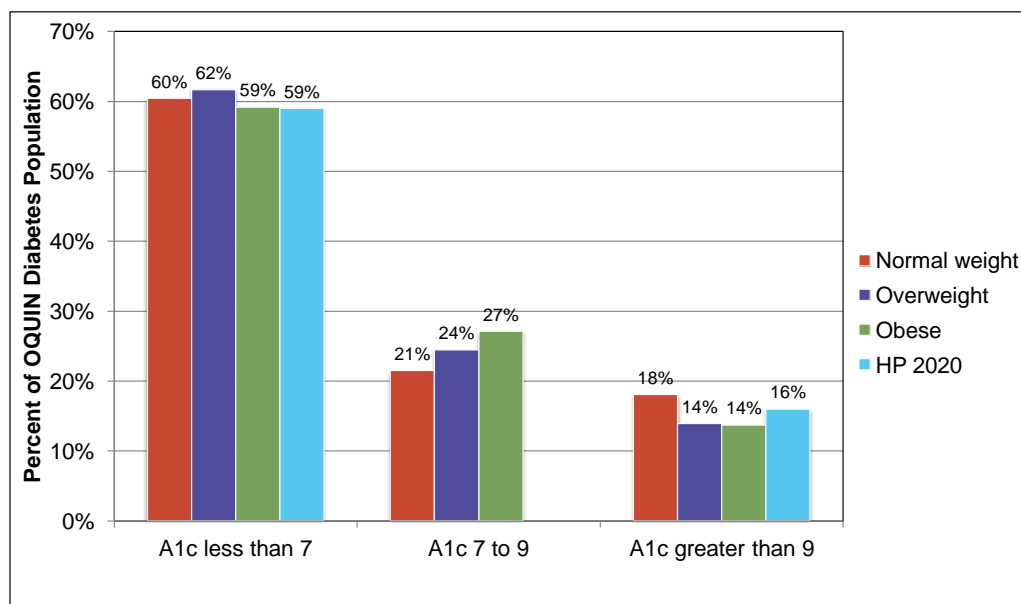
**Fig. 2.22. Percent of A1c Categories by Gender**

Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

Mean HbA1c values are presented by BMI category (Fig. 2.23). BMI was categorized into normal weight, (BMI 18.5-24.9), overweight (BMI 25-29.9) and obese (BMI of 30 or greater). The normal weight patients had 18% of their HbA1cs greater than 9.0.

**Figure 2.23. Percent of A1c Categories by BMI Category**

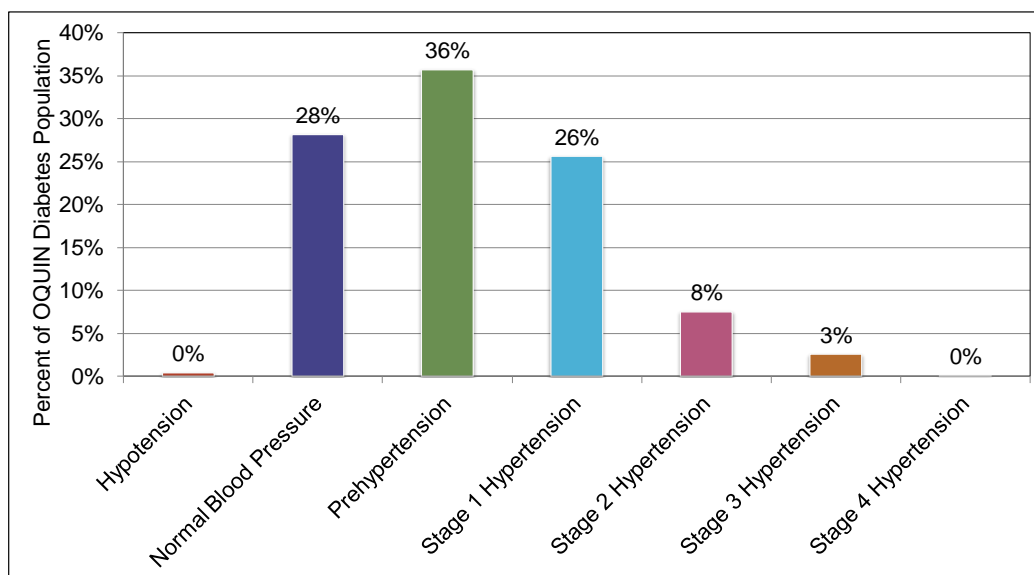


Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

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As was stated earlier, almost nine out of ten of the diabetes patients in the OQUIN diabetes database had a diagnosis of hypertension. Based on mean blood pressures, a significant number of these patients were keeping their hypertension under control. Blood pressure was categorized into seven categories. The hypertension category definitions are found in Table 2.3.

Less than one percent of the patients in the database had either hypotension, or stage 4 hypertension (Fig. 2.24). Approximately one in four (28%) had normal blood pressure, and one in three (36%) had prehypertension. Only 26% had stage 1 hypertension, 8% had stage 2 hypertension, and 3% had stage 3 hypertension.

**Figure 2.24. Hypertension Prevalence in OQUIN**

Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

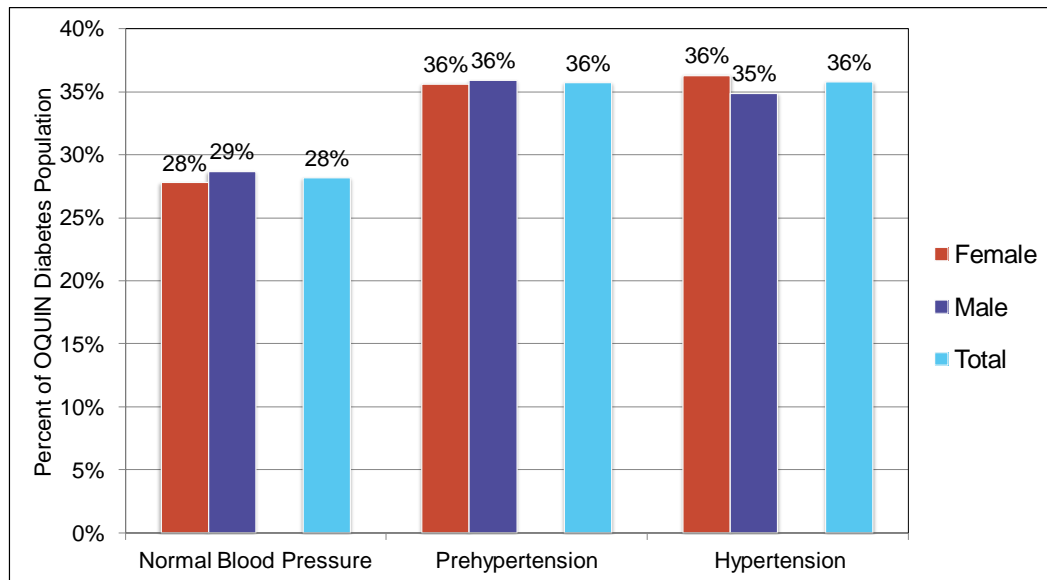
April 2013

**Table 2.3 Diagnostic Categories for Hypertension\***

Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Stages of Hypertension
210	120	Stage 4
180	110	Stage 3
160	100	Stage 2
140	90	Stage 1
120	80	Prehypertension
90	60	Hypotension

[\\*http://www.nhlbi.nih.gov/guidelines/hypertension/phycard.pdf](http://www.nhlbi.nih.gov/guidelines/hypertension/phycard.pdf)  
<http://www.vaughns-1-pagers.com/medicine/blood-pressure.14.pdf>

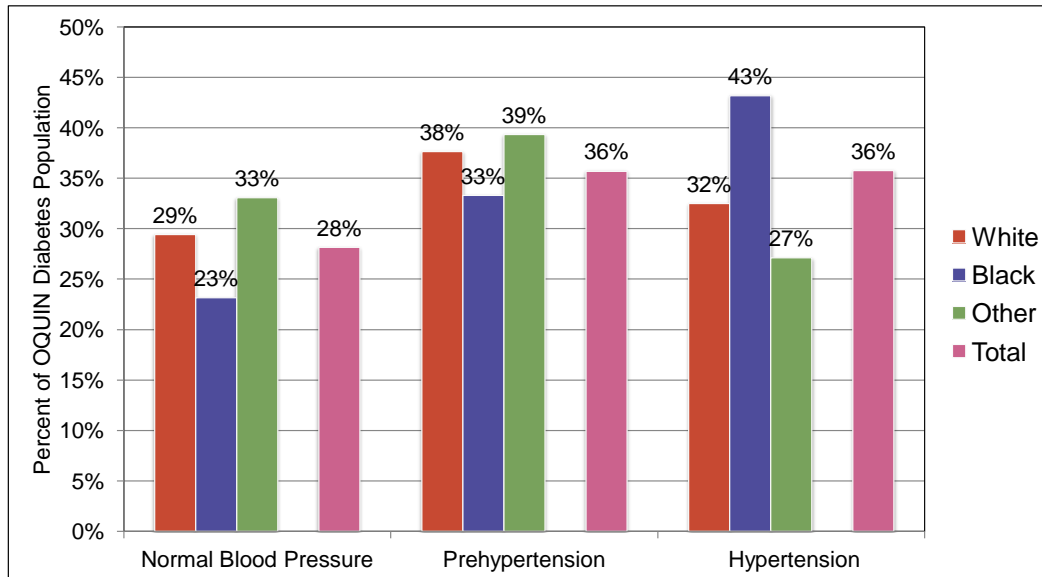
Hypertension levels in the OQUIN database differed very little by gender (Fig 2.25). Approximately 36% of both genders had hypertension and the same percentage had prehypertension, based on clinic blood pressure measurements.

**Figure 2.25. Hypertension in OQUIN by Gender**

Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

Hypertension prevalence, as indicated by in-office blood pressure readings, differed significantly by race. Almost half, (43%) of African Americans had high average blood pressures, i.e., average readings of more than 140/90, whereas only a third, (32%) of the White population had hypertension (Fig. 2.26).

**Figure 2.26. Hypertension in OQUIN by Race**

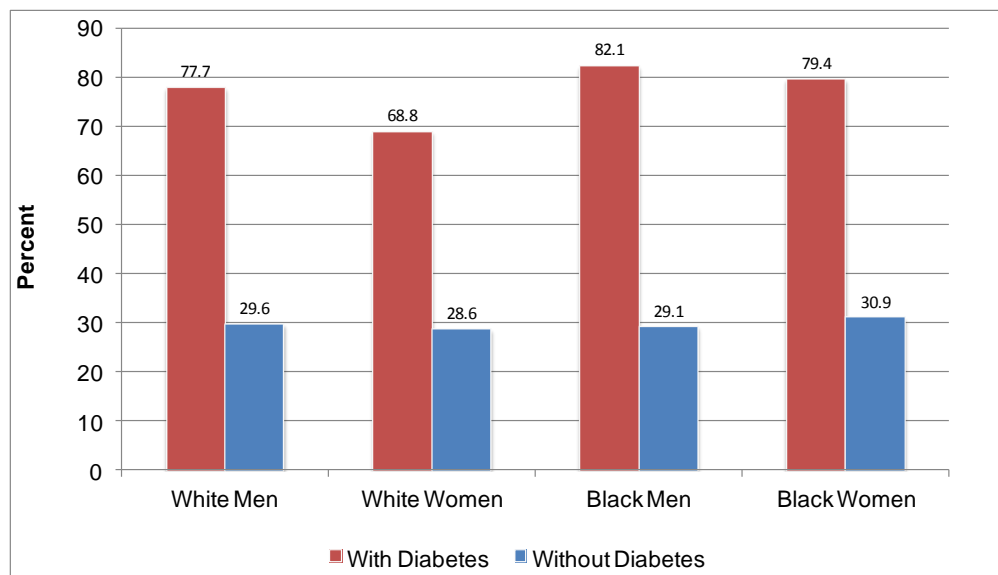
Data Source: SC OQUIN database; Generated by Chronic Disease Epidemiology and Evaluation

April 2013

People with diabetes are 2.5 to 3 times more likely to have hypertension than those without diabetes. There was very little difference in hypertension prevalence rates among race/gender groups for those either with diabetes or without diabetes. In the population with diabetes, African American males had the highest rates of hypertension, and White females had the lowest (Fig. 2.27).

Figure 2.16 to Figure 2.26 illustrate the clinical outcome captured by OQUIN. The two figures (2.27 and 2.28) shows the South Carolina adults information only by race and gender.

**Figure 2.27. Hypertension Prevalence among Adults with and without Diabetes by Race and Gender, SC 2010**

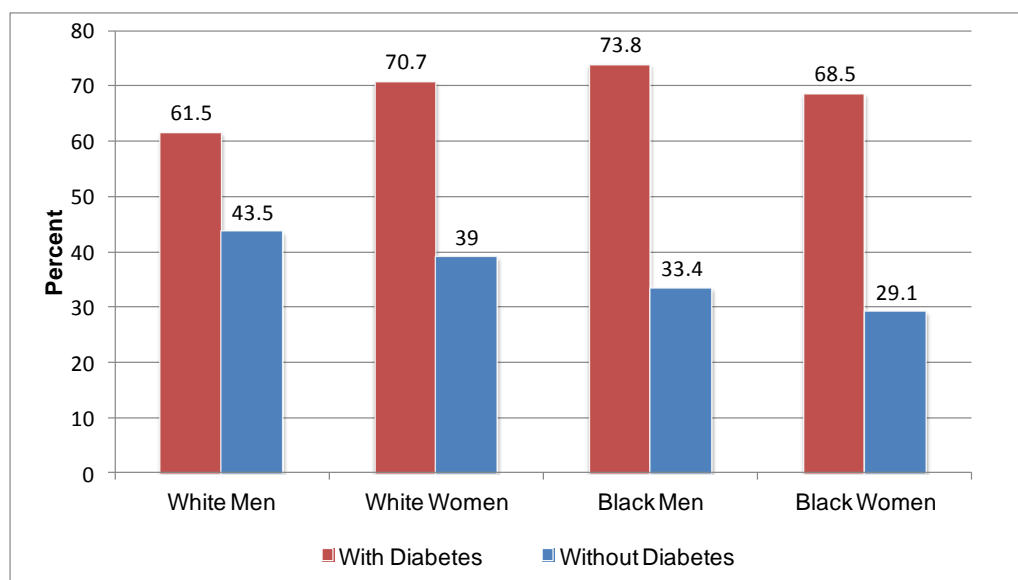


Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Prevalence of high cholesterol is much higher in people with diabetes than in those without diabetes. In the population with diabetes, African American males were the most likely to have high cholesterol, although the difference in high cholesterol prevalence among race/gender groups with diabetes is less than 10 percentage points. In those without diabetes, White males had the highest rates, followed by White females. In the population without diabetes, African American females had the highest rates of high cholesterol. In all races and genders, the population with diabetes had significantly higher rates of high cholesterol than those without diabetes. African American females had 2.4 times the prevalence of high cholesterol in the population with diabetes versus those without diabetes. White males had the lowest difference, about 1.4 times of those with diabetes versus those without. In White females and African American males, the difference in high cholesterol in the populations with and without diabetes fell between 1.4 and 2.4 times (Fig. 2.28).

**Figure 2.28. High Cholesterol Prevalence among Adults with and without Diabetes by Race and Gender, SC 2010**



Data Source: SC BRFSS; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### ***Summary***

Overall, there has been improvement in areas of knowledge of diabetes and access to prevention and intervention services. Short-term surrogate measures and actions such as HbA1c tests, foot examinations, and eye examinations have improved in recent years. The health professionals needed for treatment and management of diabetes have increased, but still not kept up with the demand. Continued efforts should emphasize major behavioral risk factor modification, racial and gender disparities in self-blood glucose monitoring, standards of care, accessibility, and affordability of care. Optimal management and treatment of diabetes and prevention of diabetes complications are a high priority of the continued efforts of the SCDHEC DPCP and the DSC.

## Chapter Three: Complications of Diabetes



*"Personally, I've experienced most of the complications that this disease can cause such as diseases of the eye, heart complications, neuropathy in all extremities, and bouts of depression. My lifestyle has changed significantly, especially with the heart disease and decline in my vision. Driving at night is a major challenge so I am dependent on others to drive me. Of the many complications that I've experienced, depression has been the most challenging; especially in my earlier years. I was diagnosed at 19.*

*It is imperative that we become educated concerning this devastating disease, which has so many complications that can destroy a person's life style as well as cause death. During my 25 years of employment, I lost at least 2 weeks every year because I was hospitalized from becoming dehydrated which caused me to go into ketoacidosis. In 1997-98 I lost vision in both eyes because the blood vessels in the retina area began to bleed out. I've had over a dozen laser surgeries and other major surgeries on both eyes. Years following I was diagnosed with glaucoma. In 2004, I developed heart disease that led to a double by-pass. I retired on disability in 2005 due to complications from diabetes. One way to prevent and/or slow down the process and complications is to educate yourselves and other family members. Try to attend classes that are available to the community and live a healthy lifestyle. "* ViNita Williams-Davis

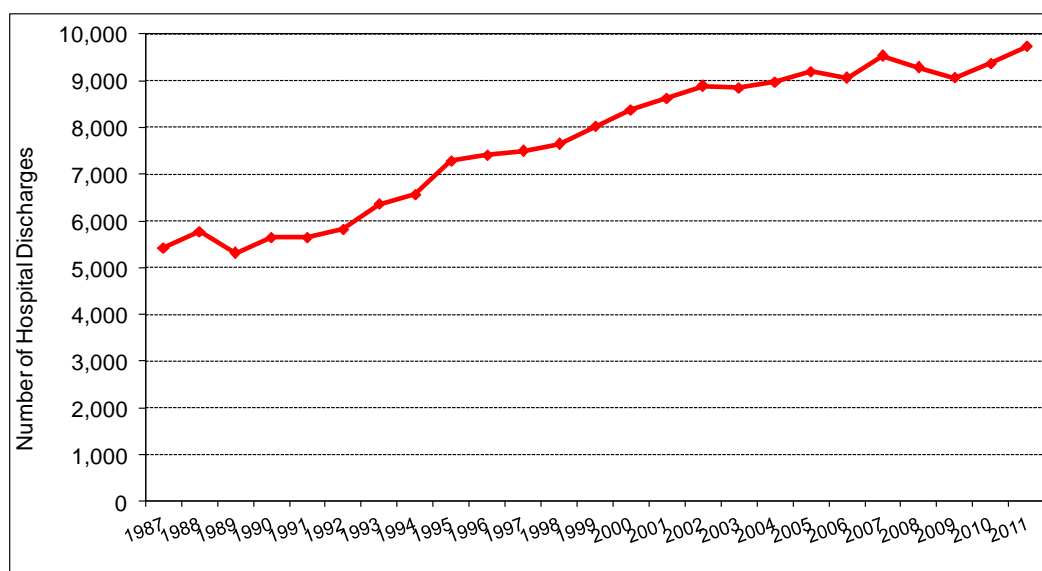
Diabetes frequently leads to complications and co-morbidities. The major complications are diabetic ketoacidosis, blindness, kidney failure, and lower extremity amputation. The most common co-morbidities include coronary heart disease, stroke, hypertension, and peripheral vascular disease. Significant high risk of complications and co-morbidities in diabetes leads to more emergency visits, hospitalizations, increased mortality, decreased quality of life, and increased health care costs.

### ***Diabetes Hospitalizations***

South Carolina had the second highest age-adjusted rate of diabetes hospitalizations in the nation (out of 42 states reporting data) at an overwhelming estimate of 289.7 diabetes hospitalizations per 100,000 population in 2008 (AHRQ, 2011). South Carolina had the sixth highest rate of hospital admissions for long-term diabetes complications and the third highest rate for short-term diabetes complications in the nation among the number of states reporting these data.

In 2010, there were 9,375 hospitalizations that had diabetes as the primary diagnosis (the main reason of hospitalization) and an additional 96,491 had diabetes as a secondary diagnosis (a co-morbidity). Nearly one out of four African American inpatients and one out of five White inpatients in South Carolina hospitals had diabetes in 2010. The number of hospitalizations with diabetes as a primary diagnosis has increased by 13% in the past 10 years and 73% in the past two decades (Fig. 3.1).

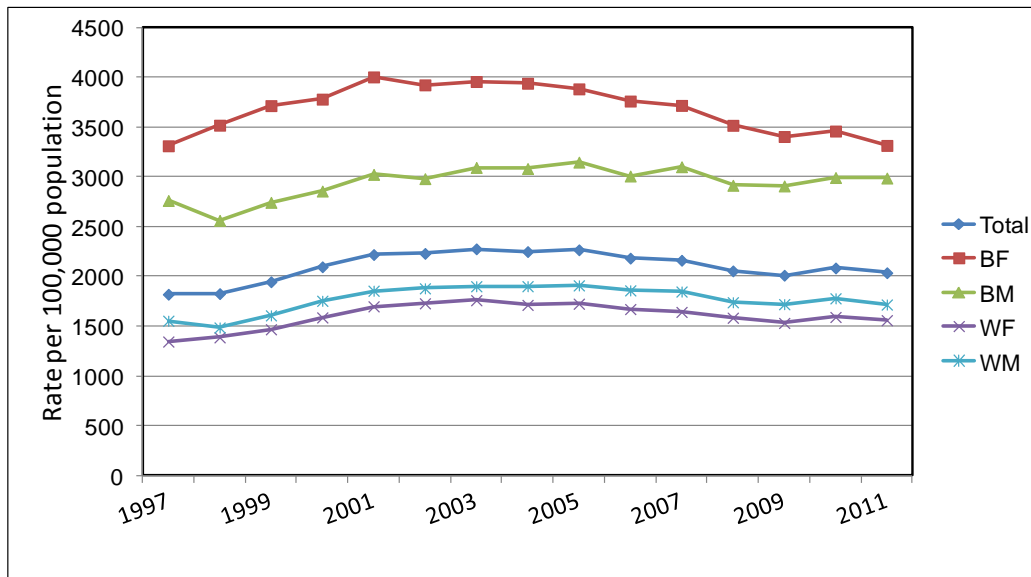
**Figure 3.1. Total Number of Hospitalizations for Diabetes as the Primary Diagnosis, SC 1987-2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation , April 2012

Age-adjusted rates for diabetes hospitalizations rose slowly through the 1990s, peaked around 2000, and then began to decline slightly. This same pattern was observed in all race/gender groups. The highest rates were in African American females, who have also shown the greatest decline. African American females have consistently had diabetes hospitalization rates two to two-and-one-half times higher than White females. African American males have rates anywhere from 60-100% higher than White males. White females have the lowest diabetes hospitalization rates (Fig 3.2).

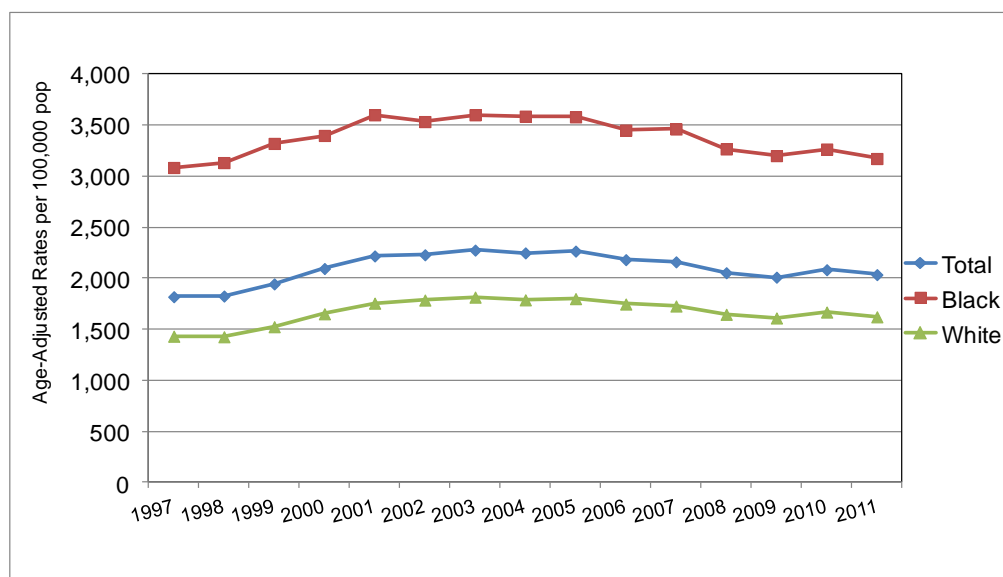
**Fig. 3.2. Diabetes Hospitalization Age-Adjusted Rates by Race and Sex, Primary and/or Secondary Diagnoses, SC 1997-2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation April 2012

Diabetes hospitalization rates in African Americans have consistently been twice as high as rates in the White population. Rates in African Americans have declined about 12% in the past decade (Fig. 3.3).

**Fig. 3.3. Diabetes Hospitalizations Rates by Race, Primary and Secondary Diagnoses, SC 1997-2010**

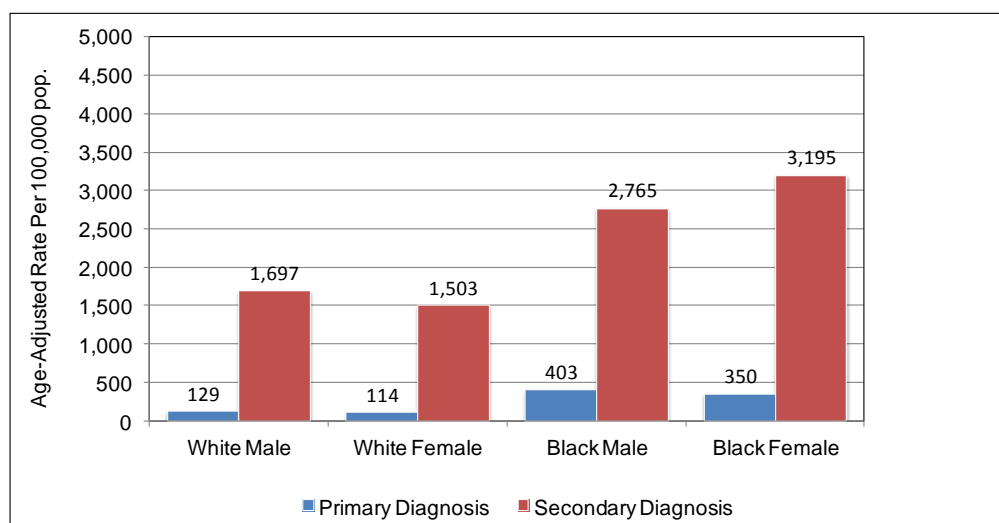


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Figure 3.4 shows the age-adjusted hospitalization rates for 2011. African American males had the highest hospitalization rates with a primary diagnosis of diabetes. African American females had the highest rates of hospitalization with a secondary diagnosis of diabetes. Both African American males and females had three times the hospitalization rates for diabetes as a primary diagnosis than White males and females. For a diabetes condition as a secondary diagnosis, African American males had twice the hospitalization rates as White males and African American females had 1.7 times higher hospitalization rates than White females.

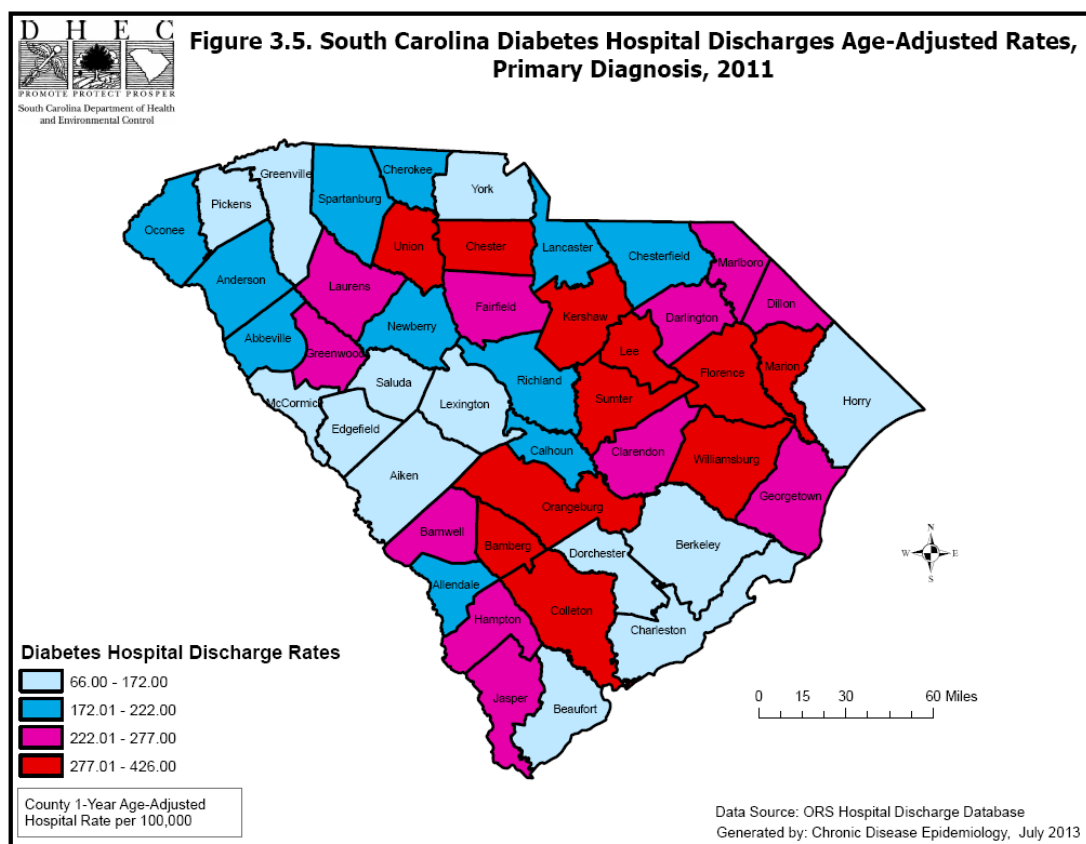
**Figure 3.4. Rate of Hospitalizations with Diabetes as Primary or Secondary Diagnosis by Race and Gender, SC 2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

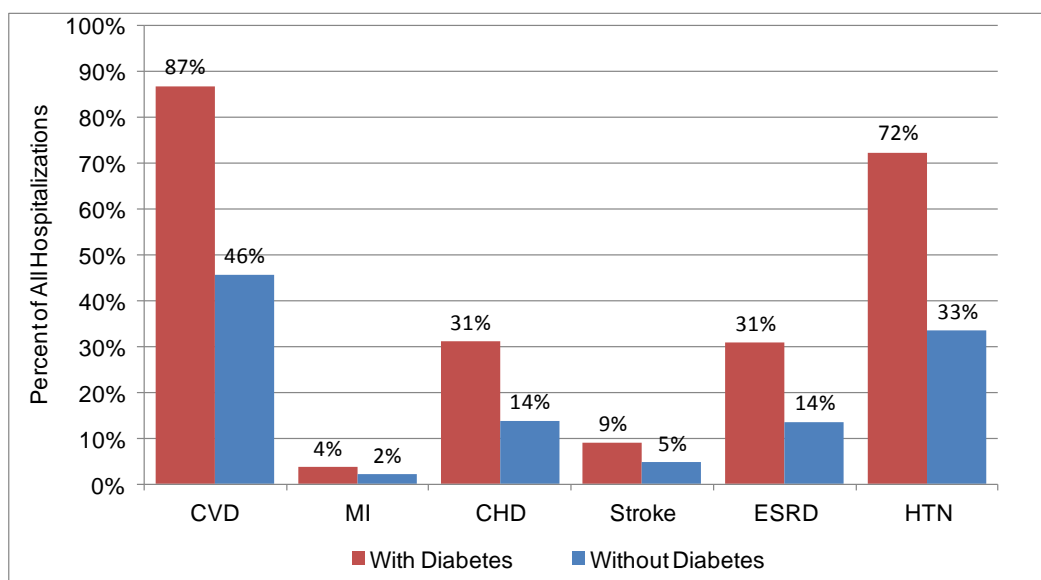
Figure 3.5 shows age-adjusted diabetes hospitalization rates by county. The highest rates were found in the eastern and southern areas of the state, and the lowest rates were in the upstate. Counties in the western part of the state adjacent to Georgia had consistently lower hospitalization rates. However, residents of these counties may be admitted to hospitals in Georgia. The same could be true for York County, as residents may routinely be admitted to hospitals in Charlotte, North Carolina. South Carolina's Office of Research and Statistics does not have records of admissions to out of state hospitals, therefore, the hospitalization and emergency department admission rates for these counties is not clearly understood.



### ***Hospitalizations for Diabetes Complications and Comorbidities***

Diabetes increases the risk for cardiovascular-related and other comorbidities. Hospital inpatient admissions for cardiovascular and renal diseases were more than twice as high in patients with a diagnosis of diabetes as in those without diabetes. Hypertension was the most common reason for hospitalization in both patients with and without diabetes, followed by end-stage renal disease and coronary heart disease (Fig. 3.6).

**Figure 3.6. Percent of Hospitalizations for Diabetes Comorbidities by Diabetes Status, SC 2010**

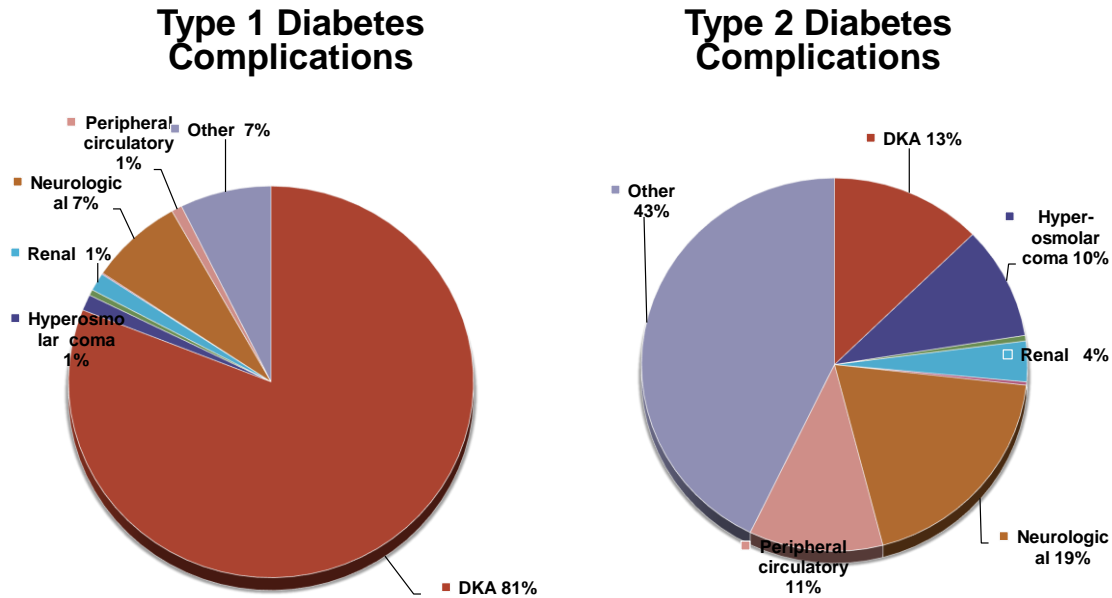


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Those patients who were admitted as inpatients with a primary diagnosis of diabetes presented with several diabetes complications (Fig. 3.7). These complications were indicated by the fourth and fifth digit of the ICD9 code for diabetes as a primary diagnosis (250.xx). The complications varied by diabetes type. The most common complication was ketoacidosis, which occurred mainly in type 1 diabetes admissions, with about 80% of those with type 1 diabetes admitted with ketoacidosis. The second most common complication was neurological manifestations, which was the single most common complication in those with type 2 diabetes, with 19% of patients admitted with neuropathy. Other complications included diabetic coma due to hyperglycemia or insulin shock, or renal problems and other unspecified complications.

**Figure 3.7. Distribution of Complications among Inpatients with Type 1 or Type 2 Diabetes as Primary Diagnosis, SC 2011**



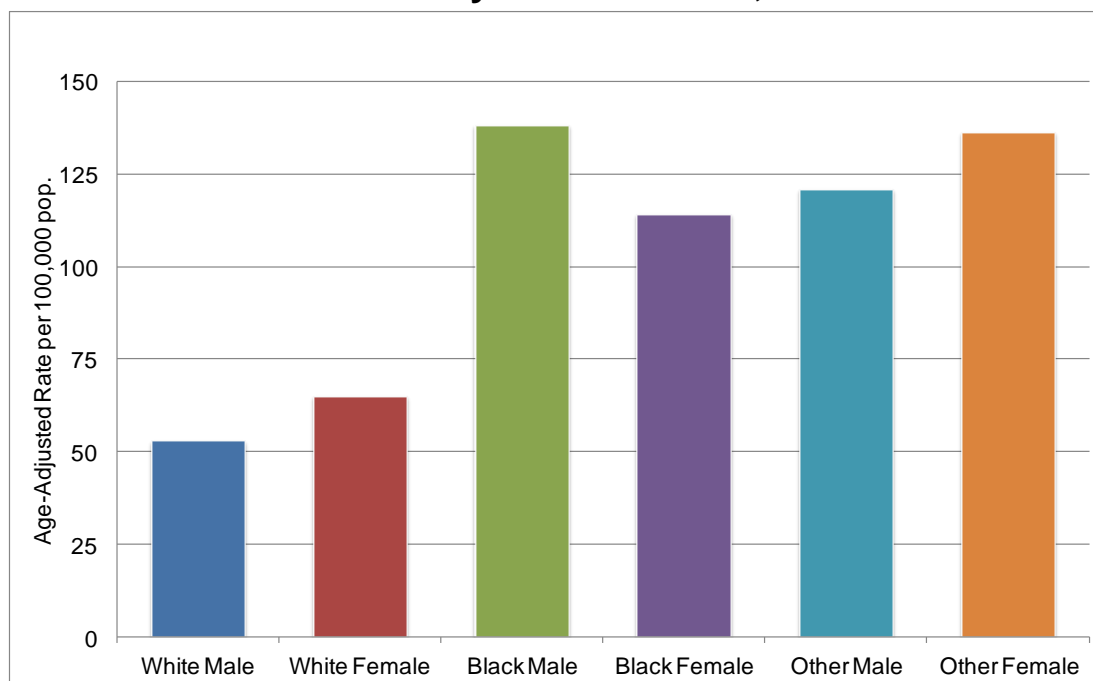
Data Source: ORS Hospital Discharge Data

### ***Ketoacidosis***

Diabetic Ketoacidosis (DKA) is a crisis for persons with diabetes, with symptoms of high blood glucose, ketonemia and metabolic acidosis and is typically one of the most common acute complications seen among patients with diabetes. DKA is caused by an accumulation of ketones in the body, resulting from extensive breakdown of fats because of faulty carbohydrate metabolism. It is characterized by a fruity odor of acetone on the breath, mental confusion, dyspnea, nausea, vomiting, dehydration, weight loss, and, if untreated, coma. Emergency treatment includes the administration of insulin and IV fluids and the evaluation and correction of electrolyte imbalance.

Both males and females in the "Other" race/ethnicity category had the highest hospitalization rates from ketoacidosis in 2011 (Fig. 3.8). African American males had the second highest hospitalization rate, 2.6 times the hospitalization rates for White males and 20% higher rates than African American females. African American females had rates 1.8 times that of White females. White males had the lowest rates of any group.

**Figure 3.8. Age-Adjusted Hospitalization of Diabetic Ketoacidosis by Race and Sex, SC 2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### ***Diabetes-Related Kidney Disease and Dialysis***

Renal failure (end-stage renal disease) is another very common manifestation of diabetes. After years of hyperglycemia accompanied with hypertension, diabetic nephropathy may lead to renal failure that requires lifelong dialysis or a kidney transplant. A University of Michigan Report (2010) using 2009 data that ranks South Carolina second only to West Virginia (not including territories) in the highest standardized mortality rates on dialysis (USDHHS, 2011). South Carolina has 114 dialysis facilities (Medicare 2012). The rate of hospitalization for renal failure was disproportionately higher among African Americans with diabetes than the rate among Whites with diabetes.

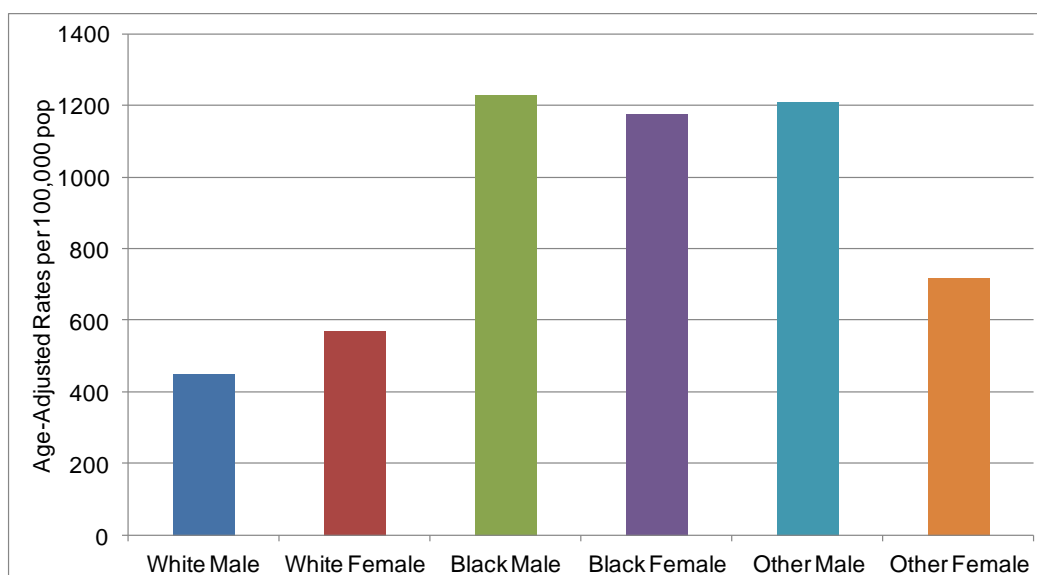
Chronic kidney disease is a comorbidity of diabetes. It can lead to diabetes complications such as end-stage renal disease and renal failure. These conditions often require a renal transplant or dialysis. Today, the disease pathways that cause damage to the kidney are better understood and kidney disease can be detected earlier than ever before with blood and urine tests. Diabetic Nephropathy is present in 20 to 40% of patients with diabetes. However, through the receipt of high quality medical care less than ten percent of people with diabetes will experience kidney failure (ADA 2012).

The ADA's Standards of Medical Care in Diabetes-2012 identifies a number of evidenced-based treatment strategies for diabetes patients to reduce the risk or slow the progression of nephropathy. Glucose control, blood pressure control, and the use of ACE inhibitors and angiotensin receptor blocker (ARB) are considered the strongest clinical strategies in the fight against the chronic kidney disease

epidemic of people living with diabetes (O'Conner, et.al.). Furthermore, their recommendations including screening people living with type 2 diabetes for renal damage at least annually.

As with many other complications, hospitalizations from diabetic renal failure (Fig. 3.9) was high in African American males, with African American females close behind. These rates were almost three times the rates in the White population. Males in the "Other" category, including Hispanic, American Indian, Asian, and any other race/ethnicity, had rates higher than African American males and rates higher than "Other" females.

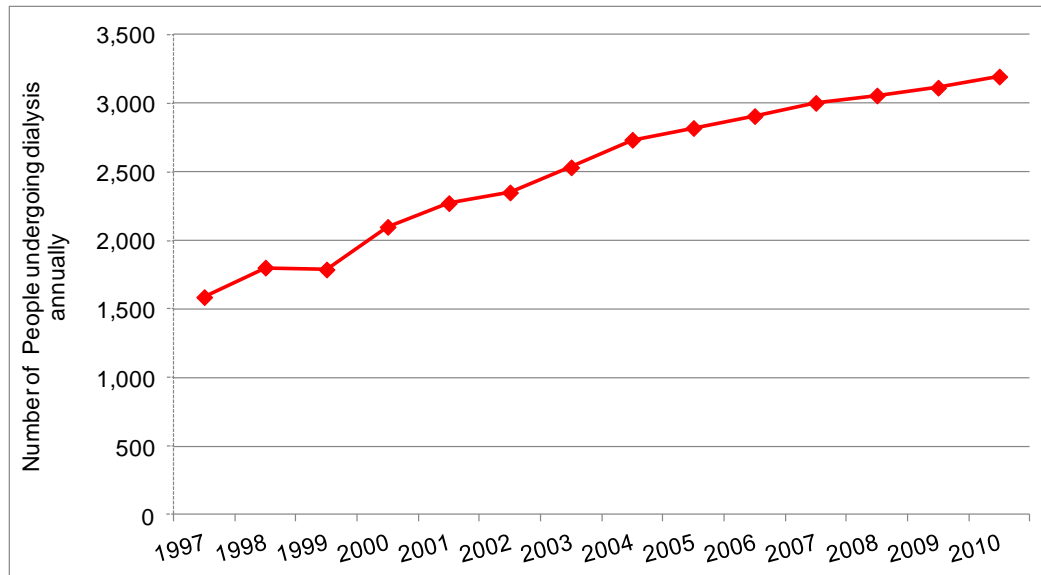
**Fig. 3.9. Age-Adjusted Hospitalization Rate of Diabetic Renal Failure by Race and Sex, SC 2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation, April 2012

End stage renal disease is one of the most serious complications of diabetes. Uncontrolled diabetes can do serious damage to kidneys over time, ultimately causing renal failure and requiring dialysis. Diabetic nephropathy is the leading cause of ESRD in the nation (ADA, 2012). The number of patients in South Carolina receiving renal dialysis due to diabetes has risen by 52% in the past decade, going from 2,099 in 2000 to 3,195 in 2010 (Fig. 3.10).

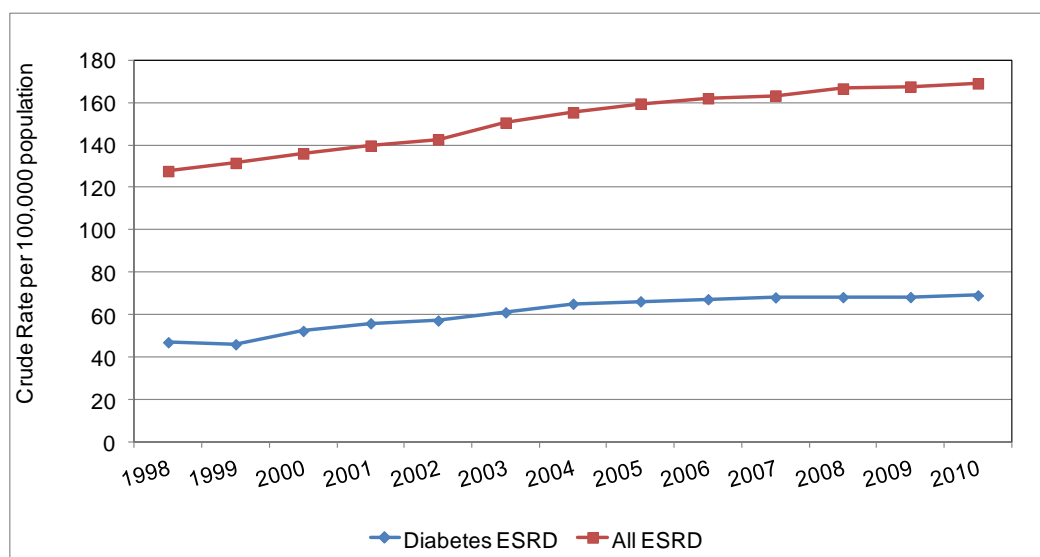
**Figure 3.10. Dialysis Prevalence with Diabetes as Major Diagnosis, SC 1997-2010**



Data Source: ESRD Network #6, SE Kidney Council Generated by Chronic Disease Epidemiology and Evaluation April 2012

Dialysis rates have been rising slowly but steadily since 2000. The two most common causes for renal failure are diabetes and hypertension. Diabetes end stage renal disease rates rose by 32% in 10 years, from 52.3 dialysis patients per 100,000 population to 69.1. All end stage renal disease rose by 24% in 10 years, from 136 dialysis patients per 100,000 population to 169.1 patients per 100,000 population (fig. 3.11).

**Fig. 3.11. End-Stage Renal Disease Attributable to Diabetes Rate\*, SC 1998-2010**



\* Number of dialysis patients per 100,000 population

Data Source: ESRD Network #6, SE Kidney Council Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### ***Lower Extremity Amputations***

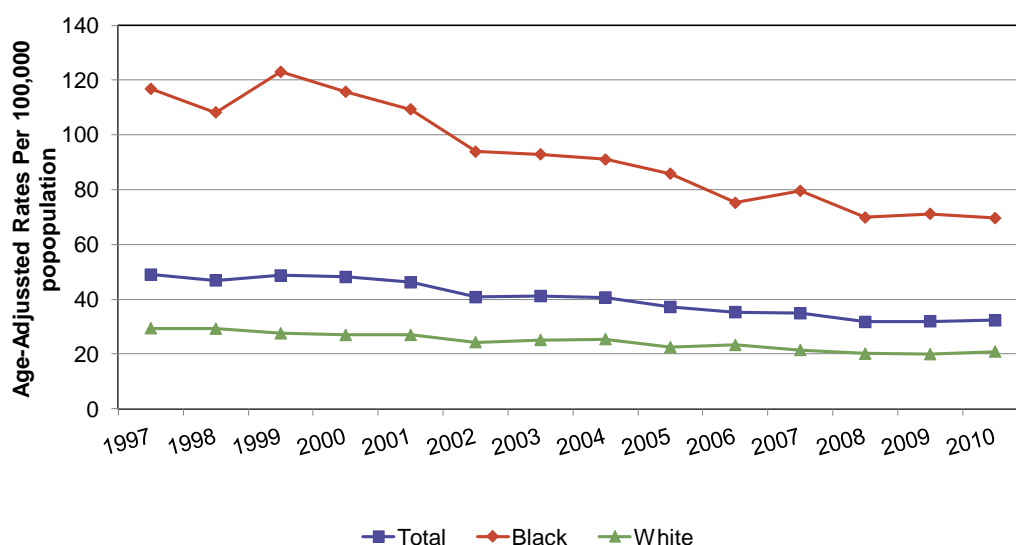
Amputations of the lower extremities, i.e. toe, foot, ankle, knee are an unfortunate complication of diabetes. These amputations are due to neuropathy, which causes loss of sensation in the foot. This may cause someone with diabetic nerve damage to be unaware of a minor wound, such as a cut, scrape or bruise. This is compounded by poor wound healing due to impaired protein metabolism in diabetes. Neuropathy is often asymptomatic, which means there will be no obvious symptoms for the patient to report to their health care provider. Thus, regular screenings for neuropathy are very important (ADA, 2012). The ADA recommends that all people with type 2 diabetes should be screened for neuropathy by a healthcare professional at least annually. There are treatment options available for diabetic neuropathy.

Without treatment of diabetes and patient self-management, the inequity in chronic care for racial and ethnic subgroups leads to serious long-term complications. Many of these, especially lower extremity amputations (LEAs), can be reduced with quality health care, ongoing diabetes self-management and control. Complications are worsening as many racial and ethnic groups fall through cracks in the system due to inability to pay, shortage of care facilities and geographic barriers in many communities, lower wages, and other social determinants. Minorities with diabetes account for the vast majority of non-traumatic LEAs (CDC, 2011). The increasing severity of this problem does not take into account the secondary lower extremity infections, which are among the top 10 reasons for hospitalizations among patients with diabetes. These infections contribute a large proportion to the

annual \$174 billion in diabetes-related costs to the U.S. healthcare system (CDC, 2011, Russo, et. Al., 2004).

In South Carolina, the 2010 overall prevalence of diabetes was 10.7% (CDC, 2011b) (8.9% in Whites and 14.1% in African Americans) (SC DHEC, 2012). More than 60% of all non-traumatic lower extremity amputations occur in people with diabetes (CDC, 2011). African Americans were 2.75 times more likely to have an amputation compared to Whites (SC DHEC 2012a, SC DHEC 2012b). LEA rates are consistently higher in African American males, but have decreased the most in African American females. Age-adjusted amputation rates have decreased by 50% in the past decade in African American females, from 103.2 amputations per 100,000 population in 2001 to 51.8 amputations per 100,000 population in 2011, and by 13% in African American males, from 111.6 amputations per 100,000 population in 2010 to 97.6 amputations per 100,000 population in 2011 (Fig. 3.12).

**Figure 3.12 Lower Extremity Amputation Rates in Patients with Diabetes by Race, SC 1997-2010**

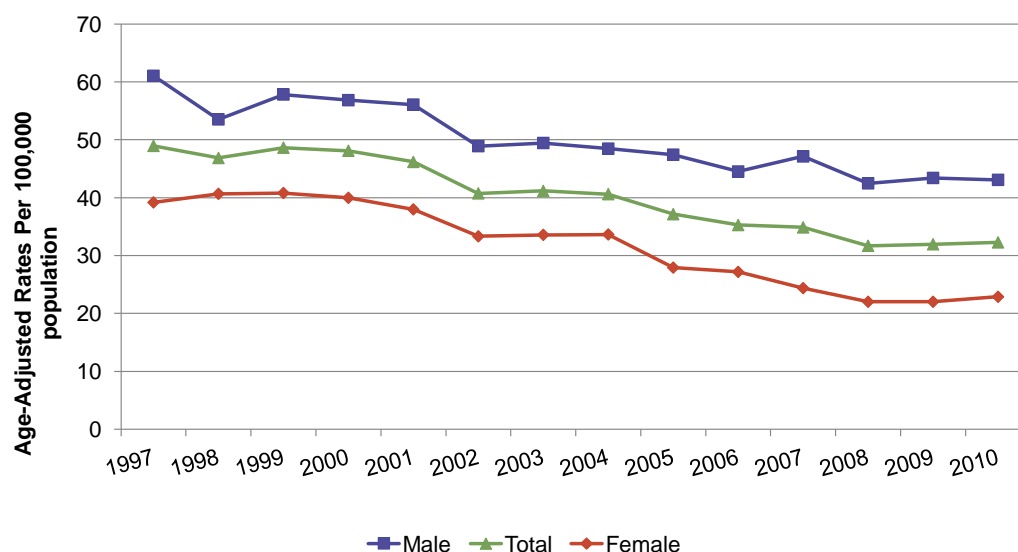


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Age-adjusted amputation rates are decreasing in all race groups (Fig 3.13). Although rates are still significantly higher in African Americans, they have decreased by 33% in African Americans, from 107.7 amputations per 100,000 population in 2001 to 71.9 amputations in 2011, and the disparity gap is narrowing. In 1999, when amputation rates in the African American population were at their peak, they were 4.5 times higher than amputation rates in the White population. By 2011, they had been reduced to 3.1 times higher than rates in the White population. This is still a significant disparity, but a substantial reduction from 4.5.

**Figure 3.13 Lower Extremity Amputation Hospitalization Rates in Patients with Diabetes by Gender, SC 1997-2010**

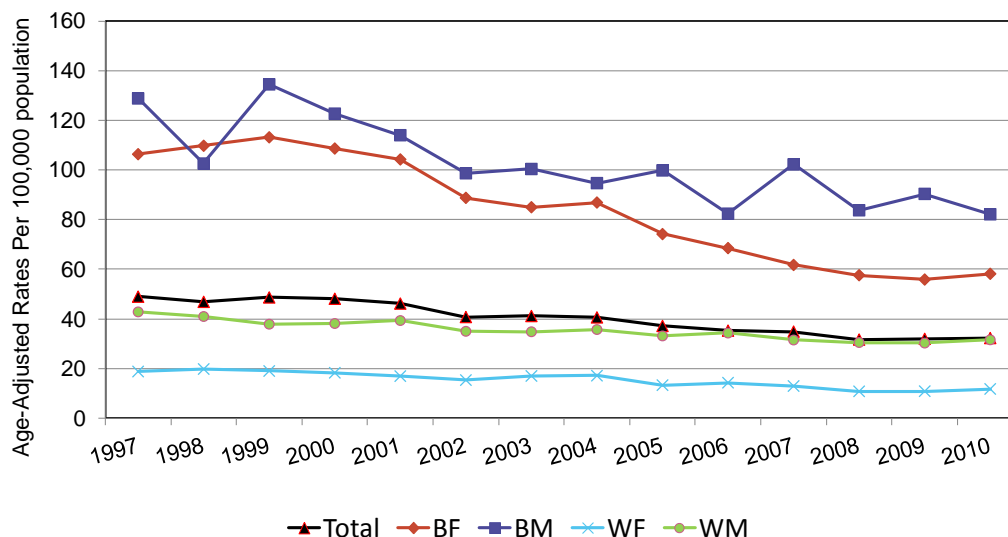


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Lower extremity amputation rates have declined significantly in both males and females after peaking in 1997 (Fig. 3.14). Rates are consistently higher in males, anywhere from 1.7 to 2 times the rates in females over the past ten years. Amputation rates have decreased by 11% in males, from 54.6 amputations per 100,000 population in 2001 to 48.6 amputations per 100,000 in 2011 and 40% in females, from 37.3 amputations per 100,000 population in 2001 to 22.5 amputations per 100,000 population in 2011. Although rates in African American females have decreased substantially in the past decade, they are still four times the rates in White females, which is a great disparity. In males, the rates for African Americans are about three times the rates for the White population.

**Figure 3.14. Lower Extremity Amputation Hospitalization Rates in Patients with Diabetes by Race and Gender, SC 1997-2010**



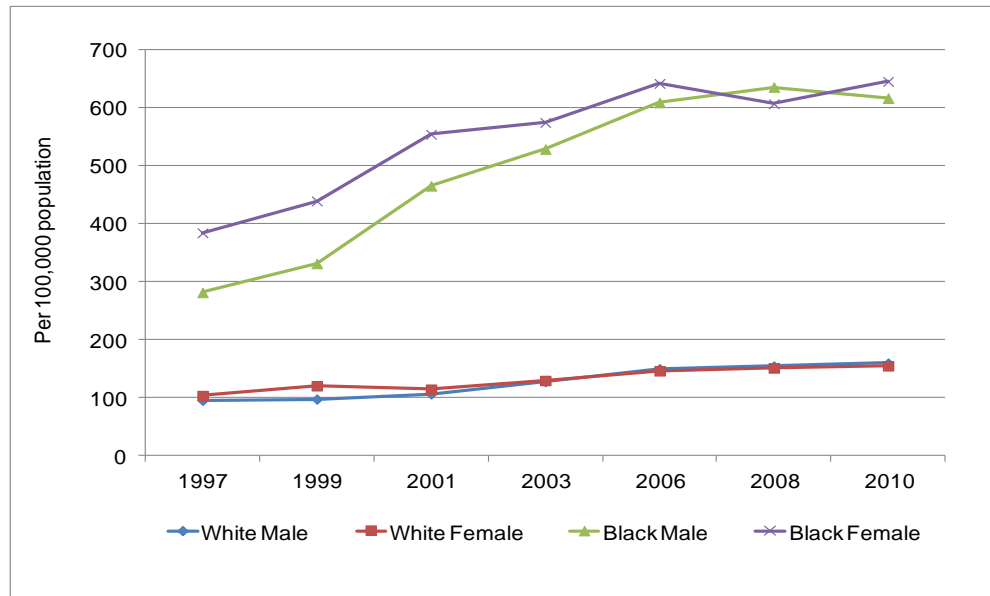
Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### ***Emergency Department Visits***

Age-adjusted diabetes-related emergency department (ED) visits for diabetes have risen substantially in the past 15 years, since data was first available in 1996. Age-adjusted rates in the White population have shown an increase since 2001. In the African American population, age-adjusted rates have increased by 83% in males, from 343.1 ED visits per 100,000 in 1996 to 626.8 visits per 100,000 in 2011, and 49% in females, from 423.5 visits per 100,000 in 1996 to 631.7 ED visits per 100,000 in 2011 (Fig. 3.15). Racial disparities for ED diabetes-related visits continue to increase. In 2011, rates for African Americans were 4.3 times that of Whites for females and 3.8 times those of Whites for males compared to 5 times for females and 4.5 times for males in 2001, a decade ago.

**Figure 3.15. Age-Adjusted Rate of ER Visits for Diabetes as the Primary Diagnosis by Race and Gender, SC 1997-2010**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Figure 3.16 shows age-adjusted diabetes-related ED visit rates by county. Most of the highest visit rates occur in the southern and eastern part of the state, and all of the highest rates are in areas that are rural and are lower income. High age-adjusted diabetes-related ED visit rates may be associated with a lack of access to primary health care providers, due to either financial barriers or a lack of available providers.

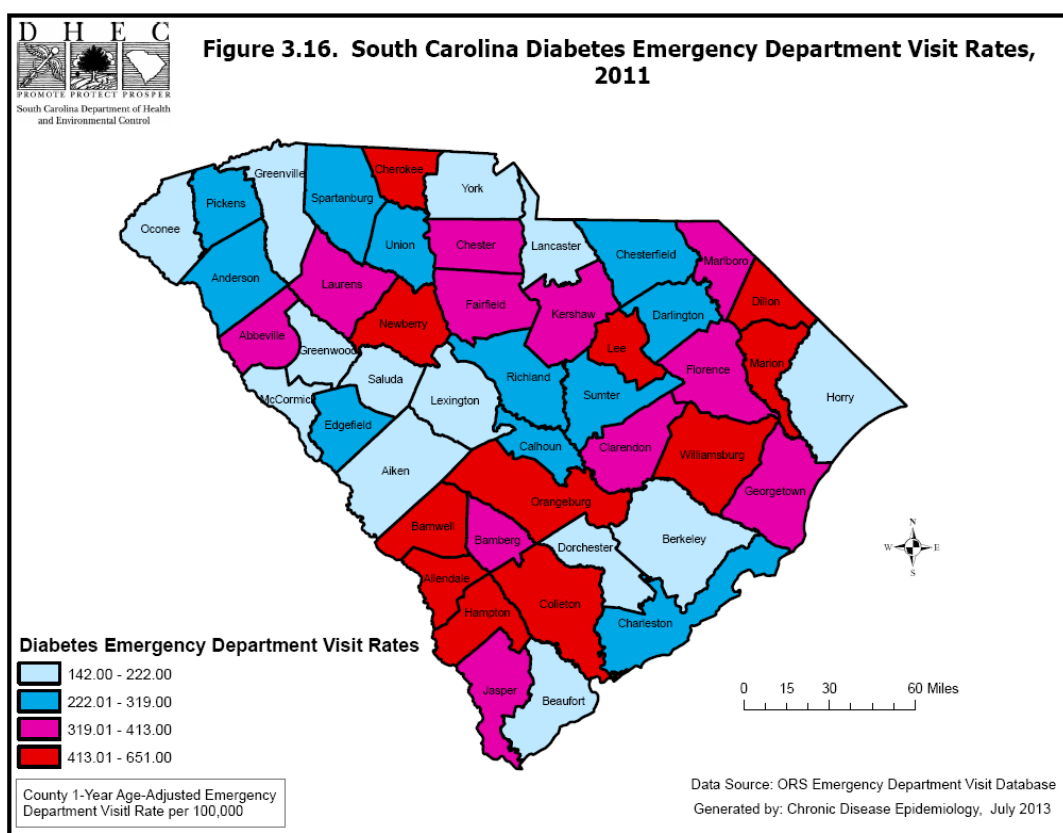
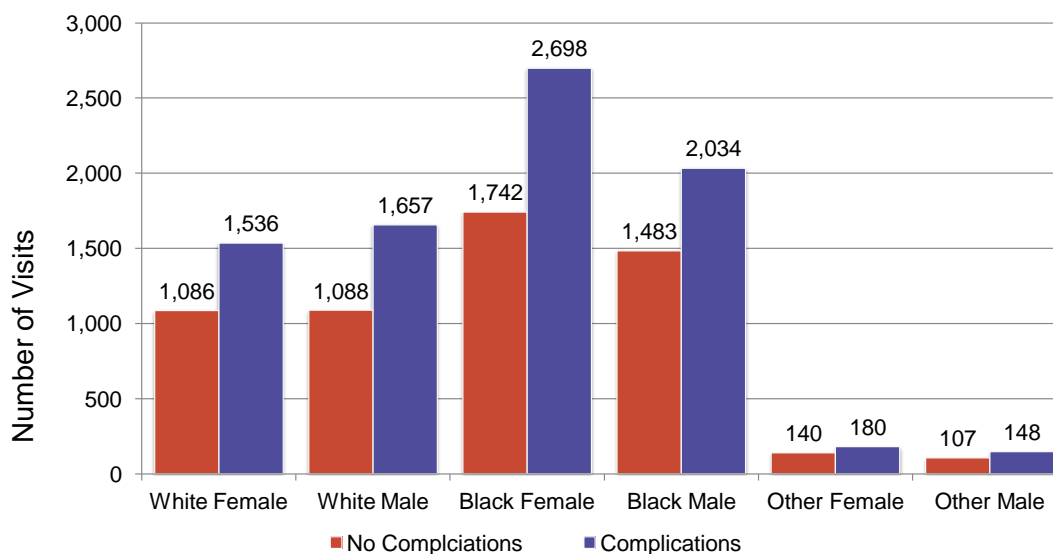


Figure 3.17 shows diabetes-related emergency department visits with selected complications, including diabetic ketoacidosis, hyperosmolar coma, hypoglycemic coma, renal complications, neurological complications or ophthalmic complications. “Uncomplicated” diabetes refers to those given an ICD9 code of 250.0. In all race/gender groups, about 60% of those presenting to the emergency department are diagnosed with complications. African American females have by far the highest number of emergency department visits with diabetes as a primary diagnosis, more than 50% higher than White females.

**Figure 3.17. Number of ER Visits with Selected Diabetic Complications\* by Race and Gender, SC 2011**



\*diabetic ketoacidosis, hyperosmolar coma, hypoglycemic coma, renal complications, neurological complications or ophthalmic

Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

Dec 2012

## Summary

In summary, we have a major problem in caring for people with diabetes in South Carolina. Emergency Department usage for routine diabetes care has increased substantially in the past 15 years. Diabetes-related end-stage renal disease is increasing at an equally alarming rate. Cases of end-stage renal disease attributable to diabetes have increased by 52% in ten years. Lower extremity amputation rates have decreased by 23% in the general population in the past 10 years, by 33% in African Americans overall, and by 50% in African American females, specifically. Emergency department visit rates for diabetes in African Americans was four times that of Whites in 2011.

## Chapter Four: Health Care Costs

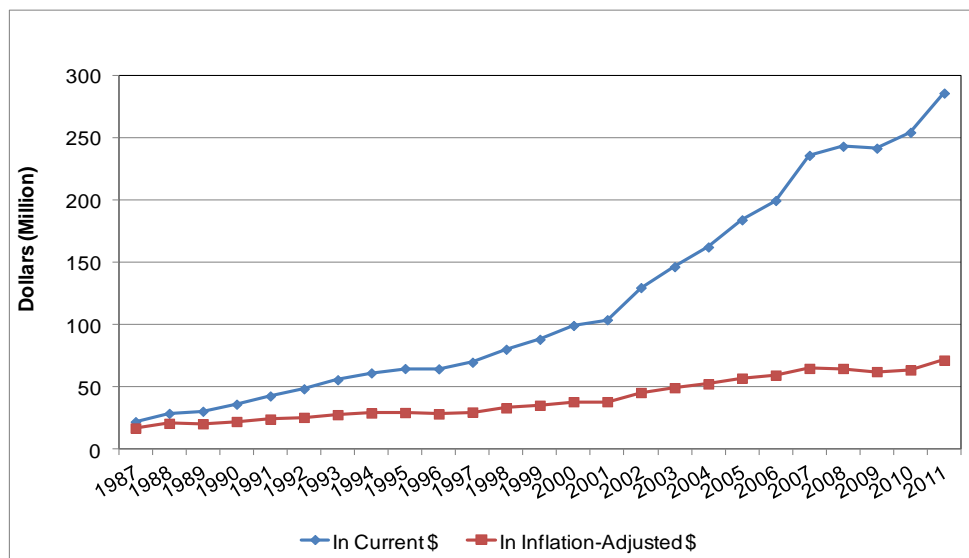
*“It is important for businesses with a high ‘diabetic’ population to develop a supportive work environment so that employees with diabetes feel comfortable adopting and performing the behaviors that promote good diabetes management. All employees will benefit from strategies for controlling diabetes because these strategies can also reduce the risk for other chronic diseases like heart disease, stroke, high blood pressure, and obesity.” – Lisa Wear-Ellington, President and CEO, South Carolina Business Coalition on Health*

Disparities in health and health care related to diabetes are common, costly, and serious, and in some cases increasing. The medical expenditures for diabetes are 2.3 times higher than medical expenditures for people without diabetes. People with diabetes experience more disease related complications and diabetes is more common in certain racial and ethnic groups, people with lower incomes and educational levels.

### Total Hospital Charges

Hospital charges have risen astronomically in the past 2 decades. In current unadjusted dollars, inpatient charges have shown a six-fold increase in the past twenty years (Fig. 4.1). Even when adjusting for inflation, hospitalization charges for diabetes have almost doubled in the past two decades (an increase of 196%).

**Figure 4.1. Total Hospital Charges (Million Current & Inflation-Adjusted \$) for Diabetes as the Primary Diagnosis, SC 1987-2011**

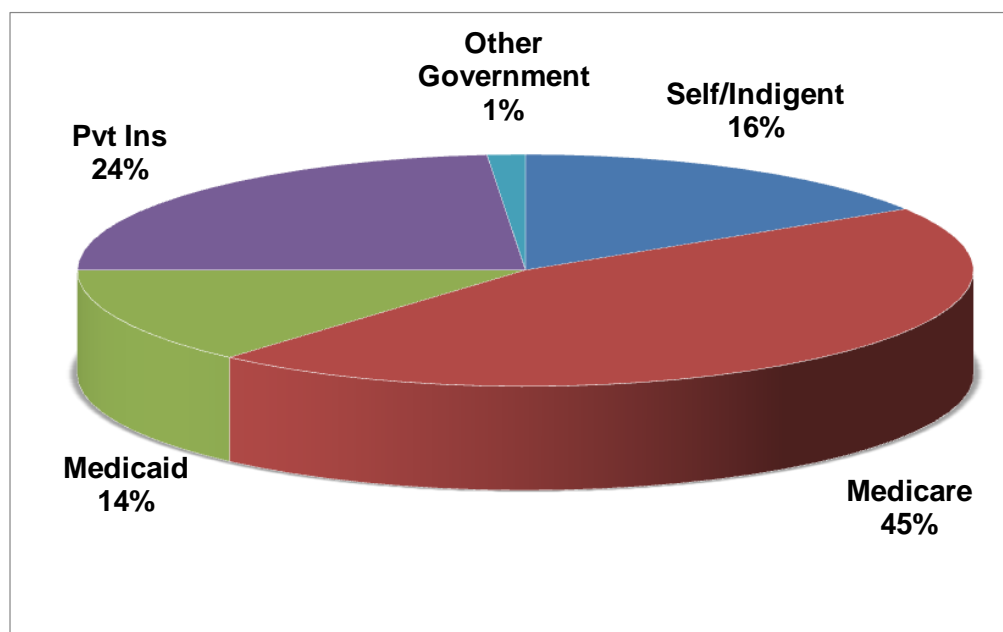


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

Dec 2012

Sources of payment for inpatient charges show that the vast majority of inpatient charges are being paid for by public funds. Medicare pays for more than 45% of these charges and when combined with Medicaid, cover about 60% of these charges. Only about one-fourth (24%) are covered by private insurers, and almost one-fifth (16%) are self-pay or indigent (Fig. 4.2).

**Figure 4.2. Sources of Payment for Hospitalization among Patients with Diabetes as the Primary Diagnosis, SC 2011**

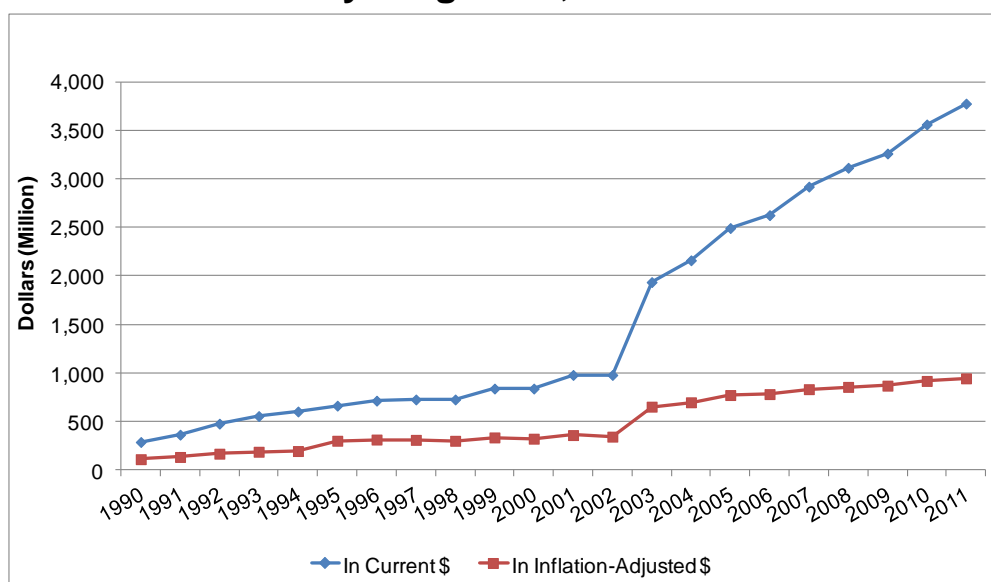


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

In current unadjusted dollars, inpatient charges for diabetes-related hospitalizations (diabetes as a secondary diagnosis) have shown a twelve-fold increase since 1990 (Fig. 4.3) and have almost tripled in the past 10 years (since 2001). Even when adjusting for inflation, hospitalization charges for diabetes-related hospitalizations have shown an almost seven-fold in the past two decades (an increase of 756%), and increased by 175% in the past 10 years.

**Figure 4.3. Total Hospital Charges (Million Current & Inflation-Adjusted \$) for Diabetes as the Secondary Diagnosis, SC 1990-2011**

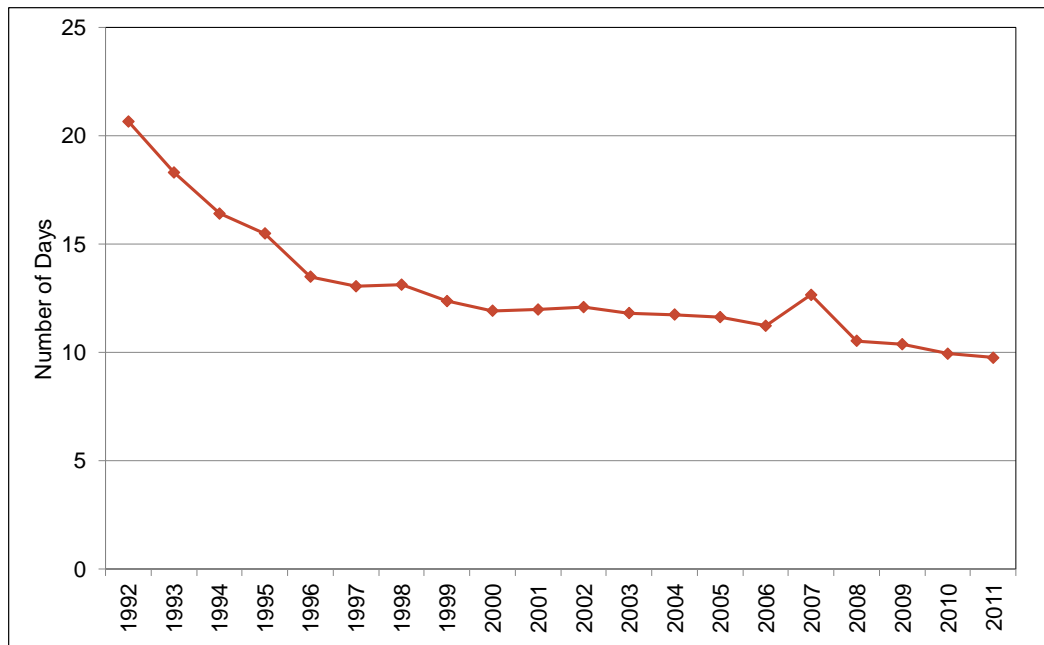


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

Dec 2012

### ***Amputation Hospitalization Charges***

In spite of the significant decreases in amputation rates, hospital charges have continued to increase. One area where significant progress has been made, however, is in length of stay. In the past two decades, average length of stay for LEAs in South Carolina dropped by 111%, from 20.1 days in 1992 to 9.7 days in 2011 (Fig. 4.4).

**Figure. 4.4. Average Length of Stay for Amputations**

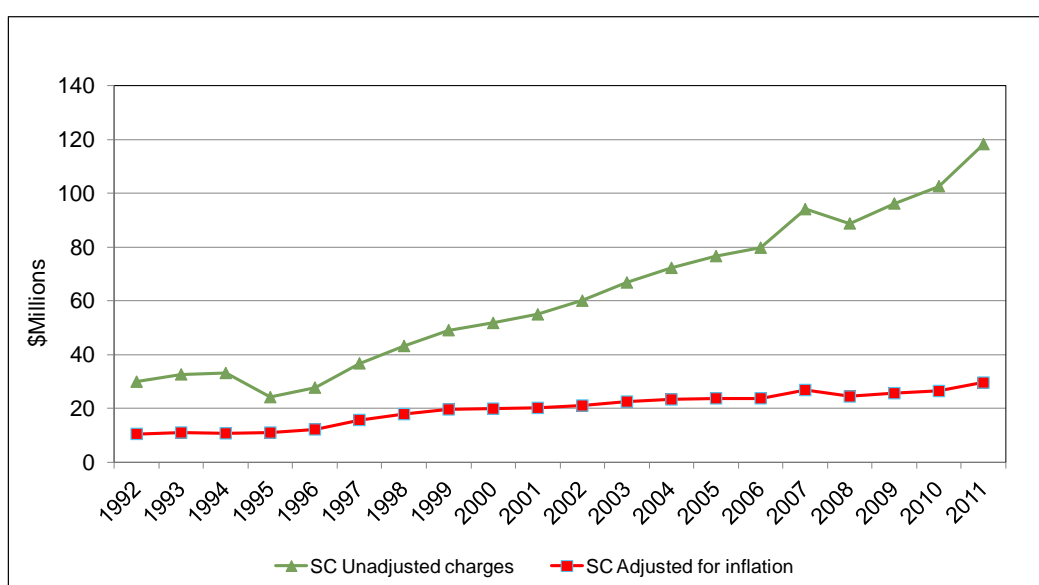
Data Source: SC Hospital Discharge Data, SC ORS

Generated by DHEC Chronic Disease Epidemiology and Evaluation Oct. 2012

A patient undergoing a lower extremity amputation in 1992 typically spent more than three weeks in the hospital at a cost, in today's dollars, of more than \$130,000, whereas the same surgery in 2011 involved a stay of just over a week, at a cost of \$45,000. Virtually no difference in average length of stay existed by race or gender. Some of this change is due to changes in policy by insurers as to maximum allowable stays in the hospital; however, it may also be true that amputations being done today are less severe than amputations done two decades ago (Bang, et al, 2012).

Hospital charges for LEAs are continuing to rise, even after adjustment for inflation (Fig. 4.5). LEA inflation-adjusted hospital charges for South Carolina overall have been increasing at a statistically significant rate of 3.4% per year. Figure 4.6 shows the LEA hospital charges for South Carolina among African Americans by gender. The increasing amputation charges occur for both genders regardless of whether adjusted for inflation or not.

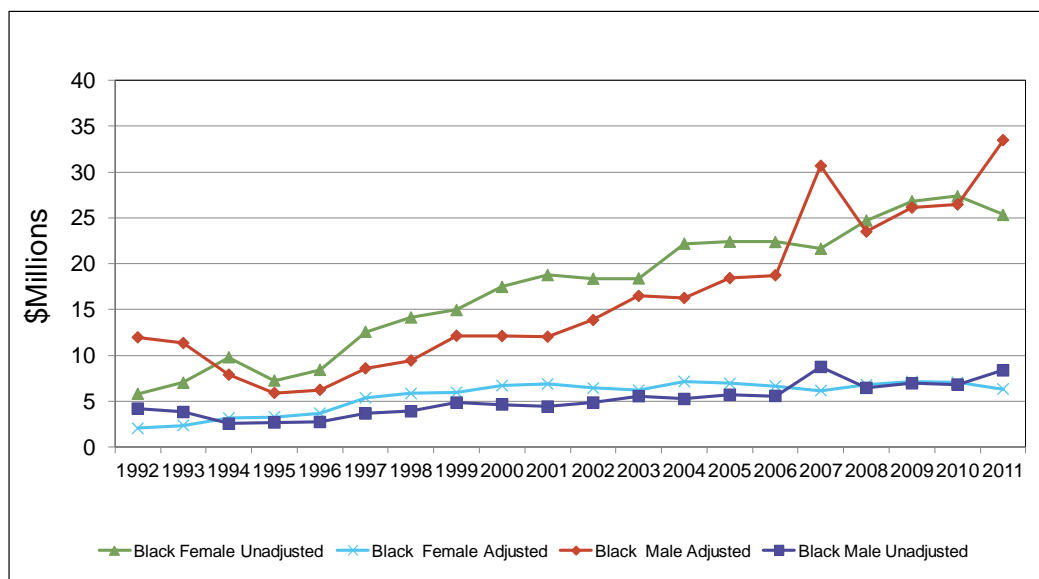
**Figure 4.5. Lower Extremity Amputation Charges: Total Charges Unadjusted and Adjusted for Inflation**



Data Source: SC Hospital Discharge Data, SC ORS

Generated by DHEC Chronic Disease Epidemiology and Evaluation Oct. 2012

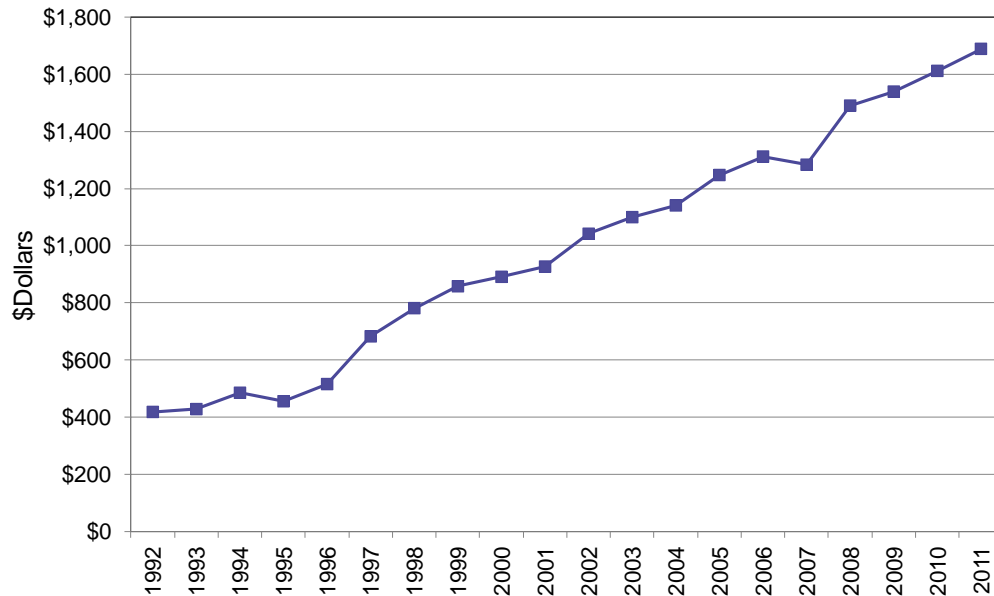
**Figure 4.6. Lower Extremity Amputation Charges:  
Total Amputation Charges in Blacks**



Data Source: SC Hospital Discharge Data, SC ORS

Generated by DHEC Chronic Disease Epidemiology and Evaluation Oct. 2012

Figure 4.7 shows average charge per person per day after inflation adjustment. These charges were computed to investigate the continually rising amputation costs, even though amputation rates have decreased in the past two decades. Average daily charges have quadrupled in the past two decades, from approximately \$400 per person per day in 1992, to more than \$1600 per person per day in 2011 (Fig. 4.6), even after adjustment for inflation. The reason for this is not clear, but provides further motivation and public health investment for aggressive efforts to reduce diabetes-related lower extremity amputations.

**Figure 4.7. Average Charge per Day for Amputations**

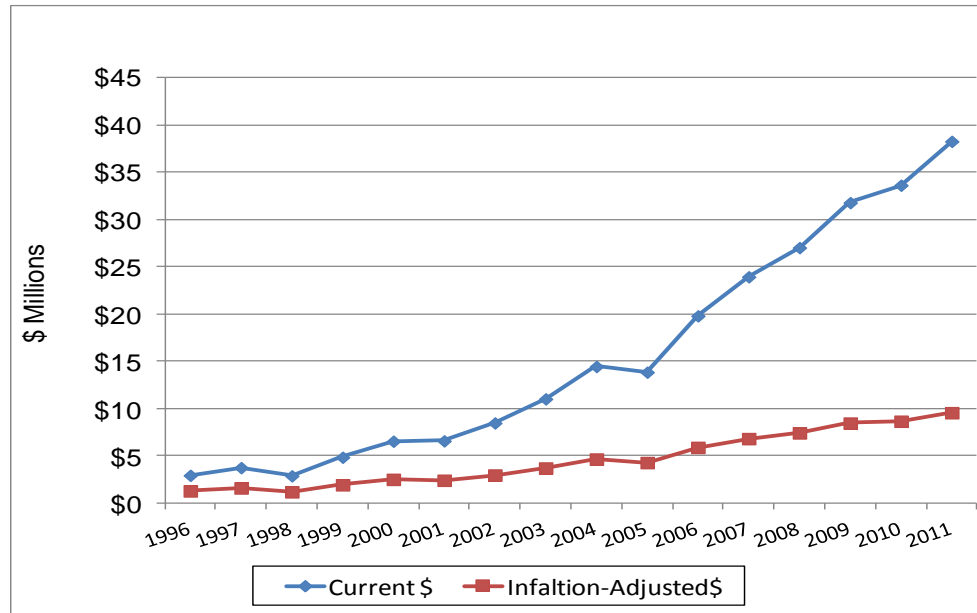
Data Source: SC Hospital Discharge Data, SC ORS

Generated by DHEC Chronic Disease Epidemiology and Evaluation Oct. 2012

### ***Total Charges for Emergency Department Visits***

Charges for emergency department (ED) visits for diabetes as a primary diagnosis have grown astronomically in the past 15 years. In unadjusted dollars, annual charges have increased tenfold, from \$2.9 million to \$33.6 million annually. Adjusting for inflation has shown that annual charges have increased to at least five times the charges in 1996 (Fig. 4.8). This is due to both increasing costs and increased utilization of the emergency department for routine diabetes care.

**Figure 4.8. Total Charges for Diabetes ED Visits  
Primary Diagnosis, SC 1996-2011**

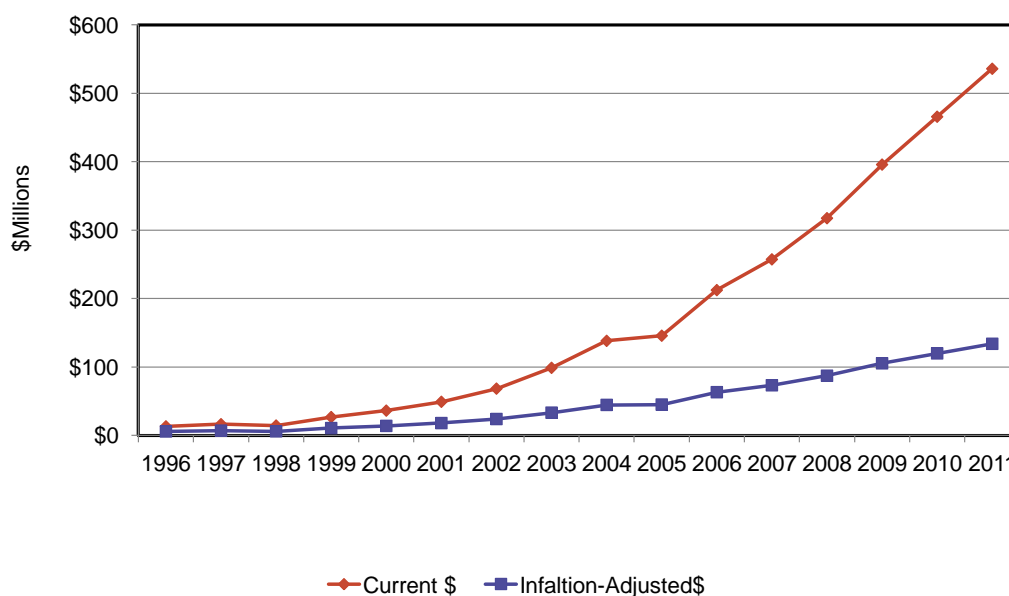


Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Emergency department charges for diabetes as a secondary diagnosis have risen even higher. In fifteen years, the unadjusted charges have increased thirty-four times, from \$13 million in 1996 to \$466 million in 2010. In inflation-adjusted dollars, the annual total charges have increased by 20 times (Fig. 4.9).

**Figure 4.9. Total Charges for Diabetes ED Visits  
Secondary Diagnosis, SC 1996-2011**



Data Source: SC Office of Research and Statistics; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### **Summary**

The total charges for all diabetes-related inpatient and emergency department visits (diabetes as a primary or secondary diagnosis) in 2011 was \$4.5 billion. Inflation-adjusted hospitalization charges for diabetes as a primary diagnosis have almost doubled in 20 years and for emergency department visits have increased five-fold since 1996, the first year data was available. Inflation-adjusted charges for diabetes-related emergency department visits have increased twenty-fold since 1996.

## Chapter Five: Mortality

Diabetes is listed as the seventh leading cause of death in South Carolina overall, resulting in about 3% of deaths, and in the White population, resulting in 2% of deaths. Diabetes is the fifth leading cause of death in African Americans (Table 5.1c), resulting in 5% of deaths, a decrease in rank from fourth in previous years. In addition to death from acute complications, diabetes increases the risk of and contributes to death from cardiovascular disease and end-stage renal disease. Although increased death rates are seen for all ages and races, minority populations and older populations experience the highest rates. The mortality data in this chapter are based on information listed on death certificates. Table 5.1a-c shows the top 10 leading causes of death for 2010 by race.

Table 5.1a. 2010 Ten Leading Causes of Death			
Rank	Condition	Number	Percent
1	Cancer	9,323	22%
2	Diseases of heart	9,253	22%
3	Stroke	2,285	6%
4	Chronic lower respiratory disease	2,263	5%
5	Accidents	2,249	5%
6	Alzheimer's disease	1,566	4%
7	<b>Diabetes</b>	1,124	3%
8	Kidney disease	958	2%
9	Influenza and pneumonia	754	2%
10	Septicemia	711	2%
	All causes	41,489	100%
Data Source: <a href="http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx">http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx</a>			

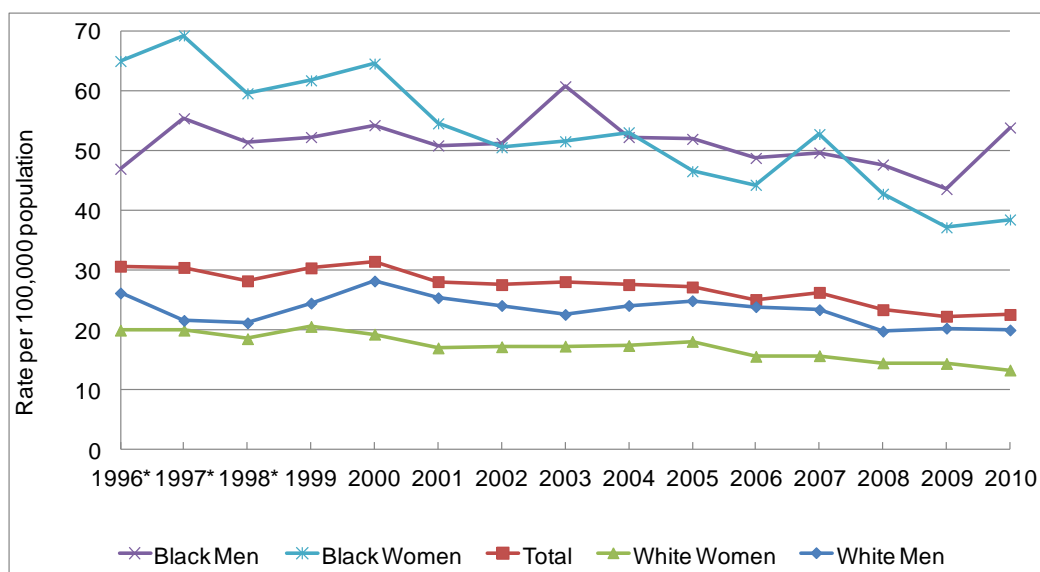
Table 5.1b. 2010 Ten Leading Causes of Death in the White Population			
Rank	White		
1	Cancer	6,826	23%
2	Diseases of heart	6,695	22%
3	Chronic lower respiratory disease	1,956	6%
4	Accidents	1,685	6%
5	Stroke	1,583	5%
6	Alzheimer's disease	1,301	4%
7	<b>Diabetes</b>	626	2%
8	Influenza and pneumonia	593	2%
9	Kidney disease	560	2%
10	Suicide (Intentional self-harm)	551	2%
	All causes	30,187	100%
Data Source: <a href="http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx">http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx</a>			

Table 5.1c. 2010 Ten Leading Causes of Death in the African American population			
Rank	African American		
1	Diseases of heart	2,442	23%
2	Cancer	2,374	22%
3	Stroke	650	6%
4	Accidents	516	5%
5	<b>Diabetes</b>	482	5%
6	Kidney disease	378	4%
7	Chronic lower respiratory disease	281	3%
8	Alzheimer's disease	249	2%
9	Septicemia	247	2%
10	Essential hypertension and hypertensive renal disease	202	2%
	All causes	10,665	100%
*Data Source: <a href="http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx">http://scangis.dhec.sc.gov/scan/bdp/tables/death2table.aspx</a>			

### ***Mortality Rates***

Diabetes mortality rates have been decreasing steadily over the past 10 years after an increase in the 1990s. Overall diabetes mortality rates have decreased by 28% in ten years. Mortality rates for African Americans have decreased about 28% in the past 10 years after a peak around 2000. However, diabetes mortality among African Americans is still three times that of the White population (Fig. 5.1).

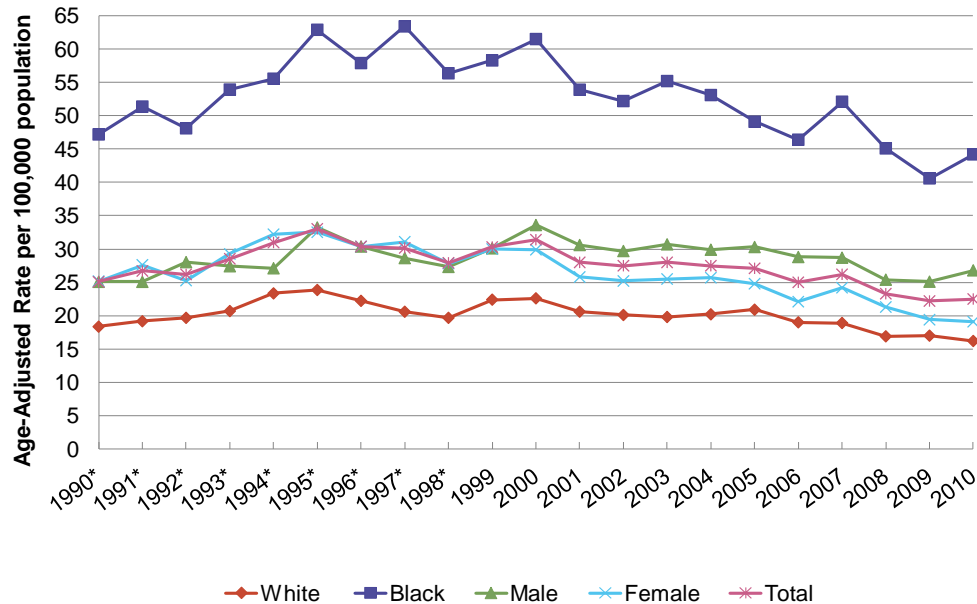
**Figure 5.1. Age-Adjusted Diabetes Mortality Rate by Race and Gender, SC 1996-2010**



Data Source: SCDHEC SCAN; Age adjusted to year 2000 population; \*Adjusted by ICD9/ICD10 Comparability Ratio 1.0193 April 2012

The largest decrease has been in African American females, whose mortality rates have decreased by 40% since 2000 from 64.5 to 38.4 deaths per 100,000 in 2010. Mortality rates for African American males have remained stable and are now the highest rates of any race/gender group. In males, the disparity gap measured by the African American/White rate ratio has become wider, going from 2.0 in 1990 to 2.7 in 2010. In females, the disparity has stayed stable at around 3.0. Therefore, even though mortality rates have fallen dramatically in African American females, they still have three times the diabetes mortality as White females (Fig. 5.2).

**Figure 5.2. Age-Adjusted Diabetes Mortality Rates by Race, Gender, SC 1990-2010**



Data Source: SCDHEC SCAN; Age adjusted to year 2000 population \*Adjusted by ICD9/ICD10 Comparability Ratio 1.0193  
April 2012

Diabetes mortality by county in Figure 5.3 depicts three-year average mortality age-adjusted rates by county. The highest diabetes mortality is found generally in the south and eastern part of the state. The counties where diabetes mortality is the highest are also rural counties where poverty rates are the highest.

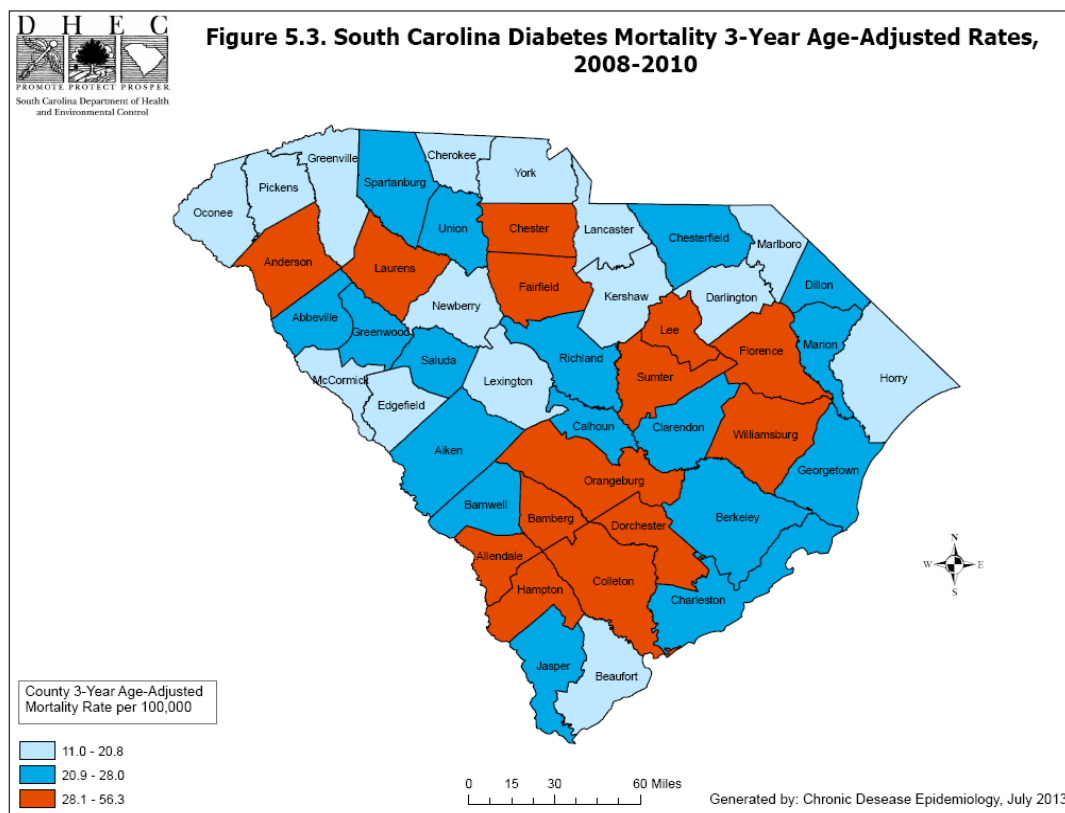
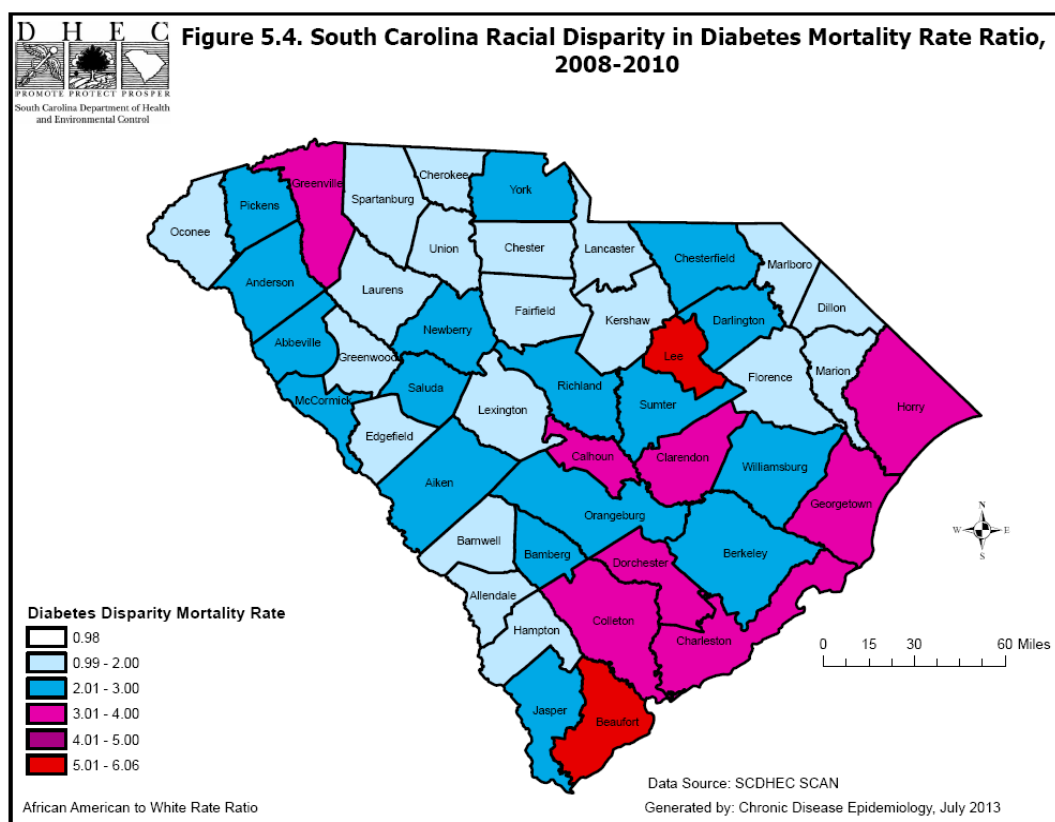


Figure 5.4 shows racial disparities in diabetes mortality, based on three-year age-adjusted mortality rates. Only one county, Fairfield, had no racial disparity. At least 30 counties had a racial disparity of two or more and three counties had a racial disparity of five or higher.

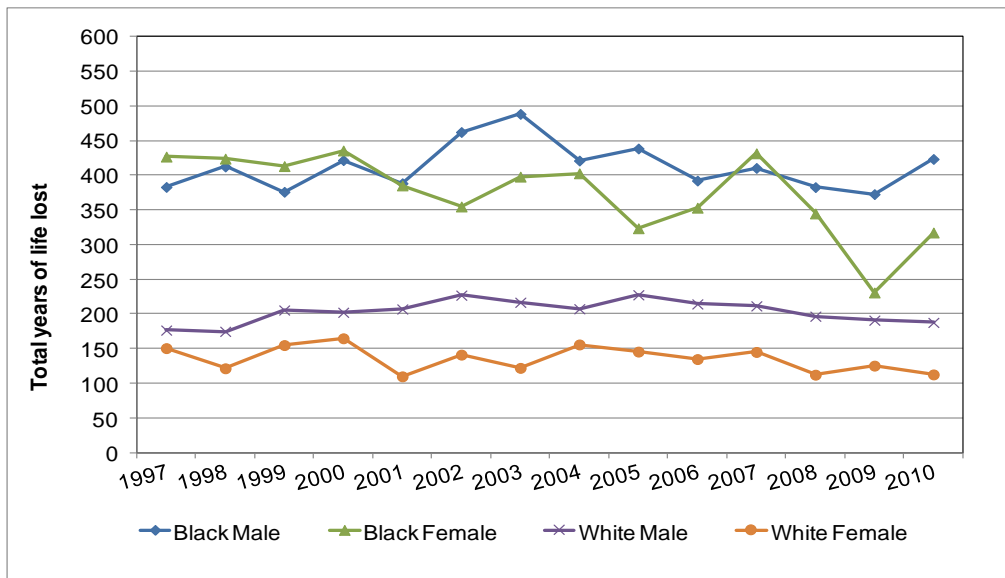


### *Years of Potential Life Lost*

Average life expectancy for people with diabetes is 5 to 10 years less than that of people without diabetes. Years of potential life (YPLL) lost refers to the added number of years that a person would have lived if they had not died prematurely of diabetes prior to age 75. (NCHS switched to YPLL before 75 in 1996.) This measure weights deaths at younger ages more heavily than deaths at older ages; the younger the age at death, the greater the number of years of potential life lost.

Figure 5.5 shows years of potential life lost before age 75. African American males have consistently had the highest years of potential life lost. African Americans have consistently had two to three times the years of potential life lost as the White population.

**Figure 5.5. Total Number of Years of Potential Life Lost for Diabetes by Race and Gender Before the age of 75, SC 1997-2010**



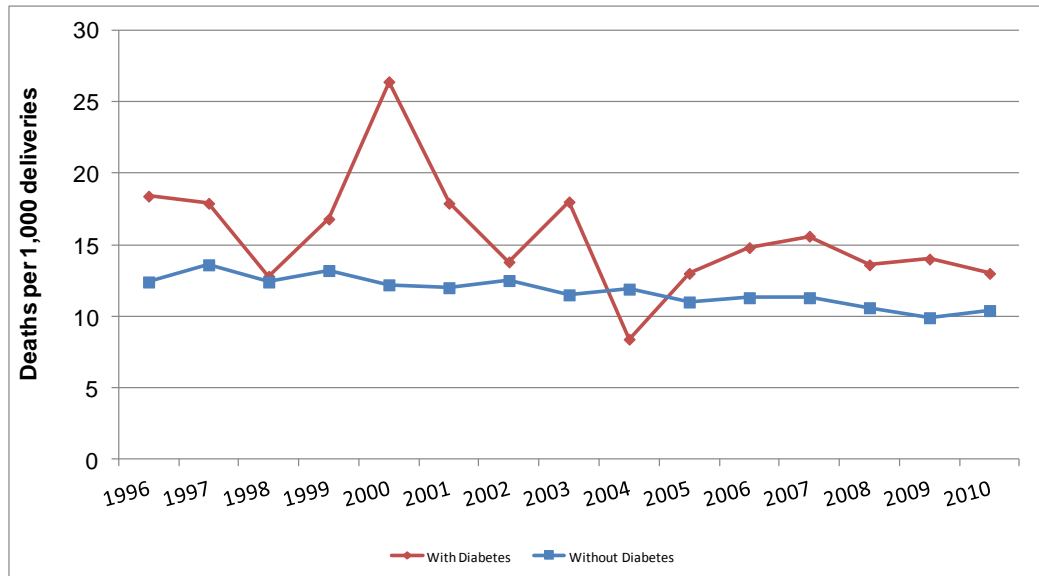
Data Source: SCDHEC SCAN; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### ***Perinatal and Infant Mortality***

Pregnant females with diabetes, either pre-pregnancy diabetes or gestational diabetes, are at higher risk for a number of poor outcomes surrounding pregnancy, birth and the infant's first year of life including infant and perinatal mortality. Infant mortality is defined as the number of infant deaths before the first birthday. The infant mortality rate is calculated by dividing the number of infant deaths by total number of live births multiplied by 1,000. Perinatal mortality which is defined as "Fetal deaths occurring during late pregnancy (at 22 completed weeks gestation and over), and infant deaths occurring during childbirth and up to seven completed days of life" (SCDHEC SCAN), has consistently been 30% to 40% higher than in mothers without diabetes. Figure 5.6 shows the rate of perinatal mortality by maternal diabetes status. Mothers with diabetes have been more at risk perinatal mortality rate than those without diabetes.

**Figure 5.6. Perinatal Mortality Rate among Mothers With and Without Diabetes, SC 1996-2010**

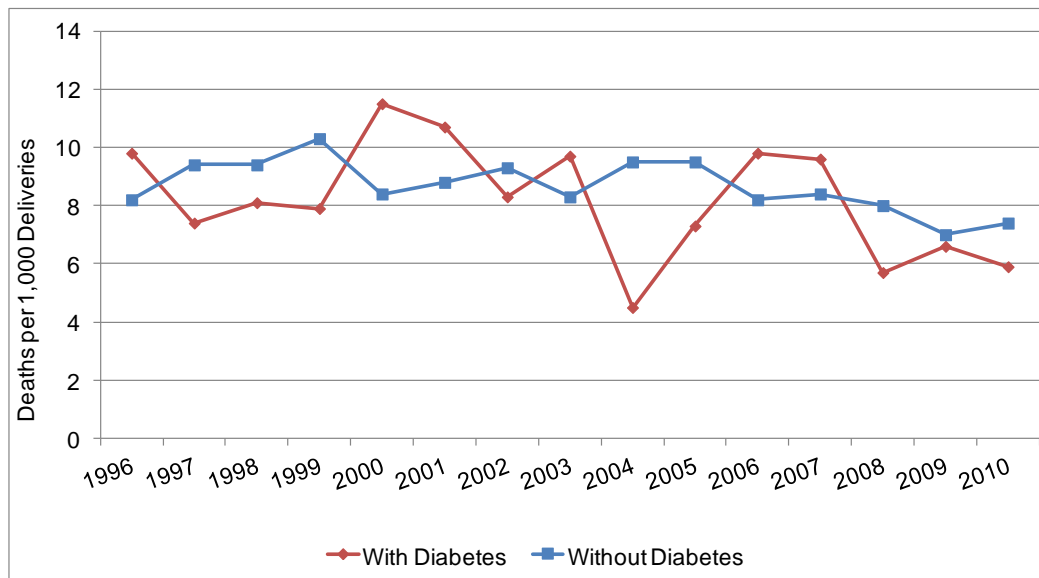


Data Source: SCDHEC SCAN; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

Figure 5.7 shows infant mortality rates in infants born to mothers with and without diabetes. No difference was found in infant mortality among these two populations.

**Figure 5.7. Infant Mortality Rate among Mothers With and Without Diabetes, SC 1996-2010**



Data Source: SCDHEC SCAN; Generated by Chronic Disease Epidemiology and Evaluation

April 2012

### Summary

Approximately 2,500-3,000 South Carolinians die from diabetes every year, including deaths from diabetes as the underlying cause and deaths where diabetes was a contributing cause. Diabetes-related mortality has decreased by 28% in the overall population, and by 40% in African American females in 10 years. The majority (82%) of deaths from diabetes occurred among people aged 60 and older. Race-sex specific mortality tracked closely with the patterns of diabetes-related risk factors and morbidity. Minorities, predominantly African Americans, experienced a substantially higher death rate, and greater years of potential life lost, approximately three times that of the White population. Culturally appropriate, innovative communication and education programs are needed to reduce the tremendous burden in this population. Meanwhile, increasing awareness, access to care, and diabetes management are critical for people with diabetes. Increasing resources for diabetes control in South Carolina, particularly rural health settings, and targeting high-risk populations are objectives of the Diabetes Initiative of South Carolina and the DHEC Division of Diabetes Prevention Strategic Plan.

## Technical Notes

The data presented in this report were compiled from a variety of sources, including census data, vital records, hospital discharge data, emergency room records, Medicare claims data, and the Behavior Risk Factor Surveillance System (BRFSS). The former data sets are complete representations of events in South Carolina; however, the BRFSS is based upon a randomly selected, interview sample of South Carolinians over age 18 years.

South Carolina relies heavily on the BRFSS as a tool to facilitate programmatic efforts in the state aimed at reducing debilitating chronic diseases and their associated risk factors. The overall goals of the BRFSS program are (1) to collect quality population-based data on health conditions, behaviors and attitudes and (2) to partner with chronic disease programs to ensure that the data is used most effectively to monitor the prevalence and trends of certain chronic diseases and their associated risk factors and also to evaluate the state programs designed to improve the health of South Carolinians.

There are limitations to the BRFSS data in terms of the representation of all regions of the state and all population groups. Rural and African-American persons are under-represented by the telephone interview system. The frequency of responses by a particular population group (e.g., 65 years and older African American females) may be rather small, so in several instances multiple years of data were pooled, or regions of the state were combined to achieve reliable frequencies for this report. In that regard, the racial composition of the data is divided into two groups, based on the designation of the census (population-level) data as White and nonwhite. Thirty percent of South Carolinians are nonwhite, of which 96% are African American.

The data on hospitalizations and emergency department visits comes from the inpatient and emergency department discharge data sets collected and maintained by the Office of Research and Statistics of the South Carolina Budget and Control Board. These data sets are compiled from billing data supplied by all civilian instate hospitals. These datasets contain information on admissions to hospitals and emergency departments, including diagnoses, procedures performed, length of stay, and charges. These datasets, while extremely valuable in chronic disease surveillance, have their limitations. Because the hospital discharge data includes only hospital discharges from all instate civilian hospitals, patients seeking health care in the hospitals outside the state or in the Veterans Administration system are not included in the data.

The YPLL for a population is computed as the sum of all the individual YPLL for individuals who died during a specific time period. This is calculated by subtracting an individual's age at death from 75 and totaling all years of life lost for each race/gender group.

A more detailed discussion of data sources, analysis methods, and case definitions used by the SC DHEC Division of Chronic Disease Epidemiology and Evaluation can be found in the Epi Technical Notes on the SC DHEC website <http://www.scdhec.gov/health/epidata/docs/EpiTechNotes.pdf>.

## Appendices

### Appendix 1. HP 2020 Objectives for Diabetes

HP 2020 Objective	Target
D-1: Reduce the annual number of new cases of diagnosed diabetes in the population.	7.2 new cases per 1,000 population aged 18 to 84 years.
D-2.1 Reduce the rate of all-cause mortality among the population with diabetes.	(Developmental)
D-2.2 Reduce the rate of cardiovascular disease deaths in persons with diagnosed diabetes.	(Developmental)
D-3: Reduce the diabetes death rate.	65.8 deaths per 100,000 population.
D-4: Reduce the rate of lower extremity amputations in persons with diagnosed diabetes	Not applicable
D-5.1 Reduce the proportion of the diabetic population with an HbA1c value greater than 9 percent.	14.6 percent
D-5.2 Increase the proportion of the diabetic population with an HbA1c value less than 7 percent.	58.9 percent
D-6: Improve lipid control among persons with diagnosed diabetes.	(Developmental)
D-7: Increase the proportion of the population with diagnosed diabetes whose blood pressure is under control.	57.0 percent
D-8: Increase the proportion of persons with diagnosed diabetes who have at least an annual dental examination.	61.2 percent
D-9: Increase the proportion of adults with diabetes who have at least an annual foot examination.	74.8 percent
D-10: Increase the proportion of adults with diabetes who have an annual dilated eye examination.	58.7 percent
D-11: Increase the proportion of adults with diabetes who have a glycosylated hemoglobin measurement at least twice a year.	71.1 percent
D-12: Increase the proportion of persons with diagnosed diabetes who obtain an annual urinary microalbumin measurement.	37.0 percent
D-13: Increase the proportion of adults with diabetes who perform self-blood glucose-monitoring at least once daily.	70.4 percent
D-14: Increase the proportion of persons with diagnosed diabetes who receive formal diabetes education.	62.5 percent
D-15 Increase the proportion of persons with diabetes whose condition has been diagnosed.	80.1 percent
D-16.1 Increase the proportion of persons at high risk for diabetes with pre-diabetes who report increasing their levels of physical activity.	49.1 percent
D-16.2 Increase the proportion of persons at high risk for diabetes with pre-diabetes who report trying to lose weight.	55.0 percent
D-16.3 Increase the proportion of persons at high risk for diabetes with pre-diabetes who report reducing the amount of fat or calories in their diet.	53.4 percent

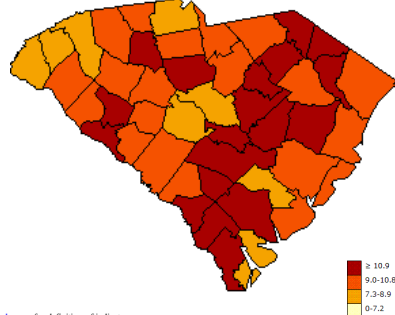
**Appendix 2. Age-Adjusted Diabetes Prevalence of Adults Age 20 and Over, 3-Year Average.**

Diagnosed Diabetes Age-Adjusted % of Adults 20+, 3 Year Average						
County	2003-05	2004-06	2005-07	2006-08	2007-09	2008-10
Abbeville	9.2	10.3	11.5	11.8	11.8	11.5
Aiken	9.8	10	9.5	9.6	9.6	10
Allendale	11.8	12.4	13	13.1	13.1	14
Anderson	10	10	10	10.7	10.9	10.7
Bamberg	11.5	12	13.5	13.2	13.3	12.6
Barnwell	9.9	10.9	12.1	12.7	12.2	11.8
Beaufort	7.9	7.3	7.2	6.8	6.9	7
Berkeley	10.2	9.8	10.8	11.4	12.5	12.3
Calhoun	10.8	11.3	11.9	11.3	11.8	12.9
Charleston	9.1	8.9	8.6	8.4	8.7	9.7
Cherokee	9.9	9.7	10.4	10.9	11.4	11
Chester	9.6	9.9	11.7	11.7	11.7	11.3
Chesterfield	9.4	9.9	10.8	11.2	11.7	11.4
Clarendon	10.8	11	11.5	11.4	12.1	12.3
Colleton	11.2	11.2	11.8	11.1	11.9	12
Darlington	10.6	11	12.7	12.2	12.2	12.6
Dillon	10.9	11.5	12.8	12.3	12.5	11.9
Dorchester	9	9.4	9.6	9.7	10.1	10.1
Edgefield	10.1	10.1	10.4	9.8	9.8	10.1
Fairfield	12	12.2	13.1	12.6	13.1	14
Florence	10.3	10.9	11.4	11.2	11	11.8
Georgetown	8.9	9.1	9.3	10.5	11	11
Greenville	8.1	8	8.1	8	8.5	9.4
Greenwood	10.3	9.8	10.3	10.3	11	10.1
Hampton	11.7	11.6	12.8	13	13.9	14.3
Horry	8.3	8.6	8.7	9	9.6	10.2
Jasper	11.2	12	12.4	13.1	12.7	12.9
Kershaw	9.4	9.8	11.3	10.5	10.6	9.7
Lancaster	9.9	11	12.2	12.1	11.3	11
Laurens	9.6	10.3	11.6	11	10.7	10.9
Lee	12.9	12.7	13.6	14	13.2	13.1
Lexington	7.8	8.8	8.8	8.4	8.5	9.1

<b>McCormick</b>	10.6	10.7	11.2	11.2	11.7	11.9
<b>Marion</b>	11.5	11.7	12.9	12.9	13.1	13.3
<b>Marlboro</b>	10.6	11	12.4	12.6	13	12.7
<b>Newberry</b>	9.5	9.9	10	9.9	10.3	10.7
<b>Oconee</b>	7.8	8.3	8.8	9.6	10.2	10
<b>Orangeburg</b>	11.7	11.8	12.9	12.6	12.9	13.5
<b>Pickens</b>	7.8	7.7	8.7	9.1	9.7	9.5
<b>Richland</b>	9.4	8.9	9.4	10.3	10.8	11.2
<b>Saluda</b>	9.1	9	9.6	10.4	10.7	11
<b>Spartanburg</b>	9.5	9.6	9.7	9.7	9.9	9.9
<b>Sumter</b>	10.9	11.1	11.8	12.2	12.3	12.8
<b>Union</b>	11.4	11.6	11.4	10.5	10.3	11.9
<b>Williamsburg</b>	11.5	11.3	12.1	11.9	12.9	13.4
<b>York</b>	8.4	8.9	9	8.7	8.8	9
<b>Source: CDC BRFSS</b>						
<b><a href="http://apps.nccd.cdc.gov/DDT_STRS2/NationalDiabetesPrevalenceEstimates.aspx?mode=DBT">http://apps.nccd.cdc.gov/DDT_STRS2/NationalDiabetesPrevalenceEstimates.aspx?mode=DBT</a></b>						

### Appendix 3. Diabetes Prevalence by County for South Carolina 2004-2009

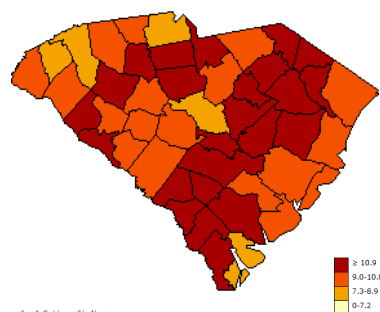
2004 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

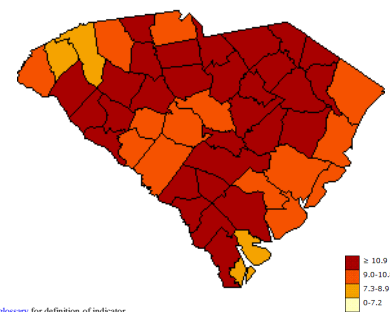
2005 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

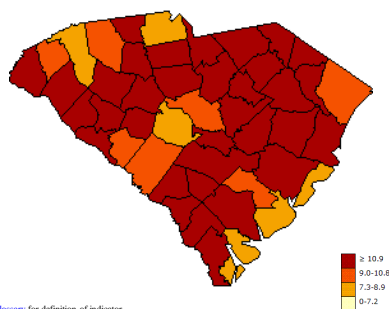
2006 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

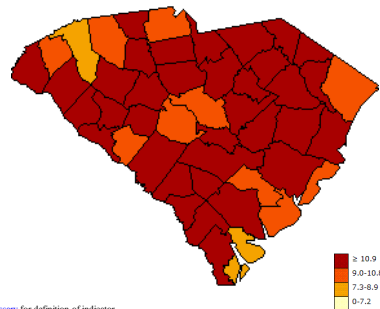
2007 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

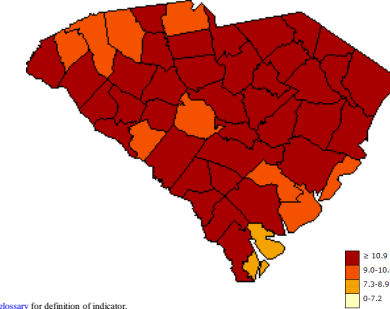
2008 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

2009 Estimates of the Percentage of Adults<sup>†</sup> with Diagnosed Diabetes in South Carolina



<sup>†</sup> ≥ 20 years old. See [glossary](#) for definition of indicator.

Source: [http://apps.nccd.cdc.gov/DDT\\_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT](http://apps.nccd.cdc.gov/DDT_STRS2/CountyPrevalenceData.aspx?StateId=45&mode=DBT)

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